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ABSTRACT

This curriculum guide was designed for use in postsecondary refrigeration, heating and air conditioning education programs in Georgia. Its purpose is to provide for the development of entry level skills in refrigeration, heating, and air conditioning in the areas of air conditioning knowledge, theoretical structure, tool usage, diagnostic ability, related supportive skills, and occupational survival skills. The first two sections of 10 explain the philosophy and objectives of state and local vocational education, and of the guide. In section 3, the occupational field of refrigeration, heating, and air conditioning is described; and employability skills, student exit points, and tasks cross referenced to the Dictionary of Occupational Titles are listed. The curriculum structure and course outline are provided in section 4, while section 5, the main part of the guide, provides unit guides for each task to be taught. (For each task, a task description, student performance objective, suggested instructional activities, instructional materials, evaluation sections, suggested classroom hours, and related instruction tasks are included.) Section 6 contains references and resources, while student record forms comprise section 7. Following suggestions for working with special needs students (section 8), the guide concludes with a facility layout for a learning resource center and a laboratory, and definitions of terms (sections 9 and 10). (KC)

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CURRICULUM GUIDE

Georgia Department of Education

REFRIGERATION, HEATING & AIR CONDITIONING

Developed Under Contractual Agreement with

Division of Program Development
Office of Vocational Education
Georgia Department of Education
Atlanta, Georgia 30334
Charles McDaniel, State Superintendent of Schools
1981

REFRIGERATION, HEATING AND AIR CONDITIONING

Developed By
The University of Georgia

Under the Direction of
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Vocational Education Materials Center
Division of Vocational Education
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POLICIES AND PROCEDURES FOR THE CENTER

PURPOSE OF THE CENTER

The Vocational Education Materials Center functions within the Division of Vocational Education, University of Georgia. This Center operates under grants from the U.S. Office of Education, and the Georgia State Department of Education with the support of the College of Education. The Center is comprehensive in its commitment and approach to the development and dissemination of materials in the broad field of Vocational Education.

The purpose of the Center is to increase the capability of Georgia's delivery system for Vocational Education. Specifically, the Center is committed to:

1. Develop materials to assist in the implementation of proposed curricula and to enhance the teaching of Vocational Education.
2. Conduct and report curriculum research related to Vocational Education.
3. Provide a production and dissemination center for Vocational Education materials.
4. Provide direct experiences in curriculum development and diffusion for advanced graduate students.
5. Enable faculty members to participate in the development and implementation of a variety of curriculum materials.

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-Foreword-

It has been the privilege of the Division of Vocational Education, University of Georgia, to participate in the development of 48 curriculum guides for Georgia vocational education programs. This work was sponsored by the Division of Program Development, Office of Vocational Education, State Department of Education. The completion of these guides meets a long standing need to provide a comprehensive curriculum overview of the vocational education programs available in Georgia schools. This developmental activity involved one of the largest professional staffs ever assembled for such work. Numerous teachers, teacher educators and state staff members have either written parts of the guides or served on the field review teams. These professionals were supported by a myriad of technical people and a host of typists who literally worked from dawn to dusk to ensure that the guides were produced in a timely fashion.

Be assured that this guide is not intended to be your curriculum or the curriculum of any school. The purpose of this project staff, and I am sure of the state OVE staff, is to offer a guide with supporting resources and teaching ideas from which the vocational instructor can extract a curriculum that meets local needs. The guide, however, does simplify curriculum decisions concerning sequencing and the selection of resources and media support.

The Task Linkage Project and appropriate V'TECS catalogs were used as the beginning point for this guide and all of the others. To assure that these task listings were directly related to Georgia vocational education programs and industry, they were subjected to additional study and review by appropriate teachers.

At some point in the future, this guide will need to be revised. To ensure that such a revision truly reflects the needs of Georgia's vocational education programs, the developers need your reactions, comments and ideas. We will also be interested in how you use the guide. Let us hear from you.

Paul Scott
Curriculum Guide Projects I & II

SECTION I

PHILOSOPHY & GOALS

VOCATIONAL EDUCATION IN GEORGIA

A. PHILOSOPHY

The Georgia Board of Education perceives vocational education as a vital component in the education of the young and adult citizens of this State. Appropriate programs of vocational education and ancillary services should be made readily available to individuals in middle schools, high schools, postsecondary area vocational-technical schools, vocational divisions of junior colleges, vocational centers, the Quick Start program and other adult programs designed to train or retrain workers for useful and satisfying employment.

Special services and assistance must be provided to those who need it in order to participate or benefit from vocational education. This includes women, minorities, the displaced homemaker and other displaced workers, those with limited English-speaking ability, the disadvantaged and the handicapped.

Since men and women spend the greater part of their lives at some form of work, the State should provide opportunities for all its citizens to develop the knowledge, skills and attitudes necessary for them to secure personally satisfying and socially useful employment.

B. PURPOSE

The purpose of vocational education shall be to improve the economic well-being of Georgia citizens by preparing individuals, through organized learning experiences, to select, obtain and advance in recognized occupations.

POSTSECONDARY VOCATIONAL EDUCATION

A. PURPOSE

The purpose of postsecondary vocational-technical education in Georgia is to improve the economic well-being of adult citizens by providing access to high quality vocational-technical training for skilled and semi-skilled occupations, for improvement of existing skills or for retraining in a new occupation.

B. OBJECTIVES

1. To provide vocational-technical education programs and ancillary services commensurate with the needs and interests of students and available job opportunities.
2. To provide vocational-technical education programs which are current with the state-of-the-art, competency-based, and offer multiple exit points to accomodate the students' occupational objectives.
3. To provide vocational-technical education programs which are articulated with available high school counterparts, to facilitate an easy transition from secondary to postsecondary levels without loss of credit.
4. To provide vocational-technical education programs such that 75% of those individuals who leave or complete a program of occupational preparation will find employment in the field, or a related field, for which trained.
5. To provide those guidance, counseling, financial aid, evaluative, job placement, remedial and other supportive programs and services needed by students to enroll, complete a program and become, or remain, employable in a skilled or semi-skilled occupation.
6. To provide needed assistance to special populations to include women, minorities, limited English-speaking, the displaced homemaker and other displaced workers, the disadvantaged and the handicapped.
7. To provide vocational-technical education programs for full-time and part-time students on campus during the day as well as the evening hours, and to provide appropriate programs for full-time and part-time students off campus in businesses and industries, comprehensive high schools and other locations within the respective schools' service areas.
8. To serve as a center for the delivery of postsecondary and adult vocational-technical education programs and services for the community and assigned service area.

STATEMENT OF LOCAL SYSTEM PHILOSOPHY, PURPOSE AND GOALS FOR VOCATIONAL EDUCATION

SECTION II

PURPOSE & OBJECTIVES

PURPOSE OF GUIDE

The purpose is defined in terms of the functional needs of each of the identified classes of users in the secondary and post secondary systems.

(a) Vocational teachers.

1. Provide a guide for organizing their program of instruction,
2. Assist in establishing program objectives,
3. Serve as a curriculum materials resource guide,
4. Improve communications with employers and advisory committees,
5. Facilitate competency based instruction,
6. Facilitate either group or self-paced instruction,
7. Include content by quarter and semester,
8. Cross-reference with existing state developed instructional materials (PLACE packages and post secondary I.I.).

(b) Vocational supervisors and administrators.

1. Assist in defining the scope and content of their programs,
2. Provide a means to improve curriculum management functions,
3. Serve as a guide for admissions and job placement functions,
4. Improve communications with employers and advisory committees.

(c) Counseling and guidance staff.

1. Provide a data base for counseling and guidance personnel,
2. Identify student exit points (Career Options),
3. Serve as guide for admissions and job placement,
4. Correlate with the new State Board of Education graduation requirements,
5. Provide specific content sequencing by quarter and semester for student scheduling,
6. Provide (a) curriculum options for the disadvantaged handicapped student, (b) curriculum modifications for SPECIAL NEEDS students, (c) typical admission requirements for regular and SPECIAL NEEDS students.

(d) Local Curriculum Coordination Committees.

1. Serve as a guide in working out articulation arrangements,
2. Improve definitions of the relationship between secondary clusters and post secondary specialized programs.

This guide will serve as an ideal communication device between school personnel and the craft advisory committee. By personally reviewing the guide with the local craft advisory committee the teacher will be able to maintain the accuracy of the guide in terms of the local job market and will also be able to inform representatives of local industry regarding the content of the program itself.

REFRIGERATION, HEATING AND AIR CONDITIONING
PROGRAM OBJECTIVE

Given appropriate instruction, as suggested by this guide, a student completing the program should demonstrate entry level job skills in Refrigeration, Heating and Air Conditioning in the areas of knowledge, theoretical structure, tool usage, diagnostic ability, related supportive skills and occupational survival skills.

As the student progresses through the program, sufficient competencies will be acquired to enable the student to enter the occupational field at the following curriculum exit points.

Refrigeration Mechanic	(D.O.T. Code 637.261-026)
Refrigeration Unit Repairer	(D.O.T. Code 637.381-014)
Window Air Conditioner Installer-Servicer	(D.O.T. Code 637.261-010)
Air Conditioner Installer	(D.O.T. Code 827.464-010)
Environmental Control System Installer-Servicer	(D.O.T. Code 637.261-014)
Environmental Control System Installer-Servicer Helper	(D.O.T. Code 637.664-010)
Hot Air Furnace Installer-Repairer	(D.O.T. Code 869.281-010)

SECTION III

D. O. T. DESCRIPTION, EXIT POINTS, TASKS

DESCRIPTION OF OCCUPATIONAL FIELD

The primary purpose of this section is to provide a general orientation to the occupational field. This orientation may be used by counseling and guidance staff in helping students to select subject areas. It may also be used by instructors for new students just entering the program area. The description delimits the scope of the occupational field in terms of the range of activities involved in a series of occupations. It contains information about career potential within the occupational field, including job market conditions and trends.

The description identifies prerequisite skills and knowledge for those students interested in entering the occupational field. In addition, the Description of Occupational Exit Points is provided to aid the instructor in identifying possible jobs for early leavers. A listing of employability skills is also included in this section.

AIR-CONDITIONING/HEATING*

Nature of the Work

People always have sought ways to make the buildings they live, work, and play in more comfortable. Today air-conditioning and heating systems control the temperature, the humidity, and even the cleanliness of the air in homes, offices, factories, and schools. In addition, refrigeration equipment makes it possible to safely store food, drugs, and other perishable items. Air-conditioning, heating, and refrigeration mechanics are skilled workers who install, maintain, and repair such systems and equipment.

Air-conditioning, heating, and--in some cases--refrigeration is not done by a single machine. Central air-conditioning, for example, requires fans, compressors, condensers, evaporators, and other components. Metal ducts or special piping are needed to distribute cooled air or chilled water throughout a building. Mechanics must be able to work with the complete system-- the machinery, and the ducts and the pipes.

Mechanics may specialize in installation or in service--maintenance and repair. Some work only with certain equipment. However, it is not uncommon for mechanics to do installations and service and to work with cooling, heating, and refrigeration equipment.

Air-conditioning and refrigeration mechanics install and service central air-conditioning systems and a variety of refrigeration equipment. When installing air-conditioning or refrigeration systems, mechanics put the motors, compressors, condensing units, evaporators, and other components in place, following blueprints and design specifications. They connect this equipment to the duct work, refrigerant lines, and electrical power source. After making the connections, they charge the system with refrigerant and check it for proper operation.

When air-conditioning and refrigeration equipment breaks down, mechanics diagnose the cause and make repairs. To find defects they inspect parts such as relays and thermostats. During the winter, air-conditioning mechanics inspect the systems and do required maintenance, such as overhauling compressors, recharging the system's refrigerant, or adjusting the air flow in the ducts. Some mechanics service heating systems.

Furnace installers also called heating equipment installers, follow blueprints or other specifications to install oil, gas, and electric heating systems. After setting the furnace in place, they install fuel supply lines, air ducts, pumps, and other components. They then connect electrical wiring and controls, and check the unit for proper operation.

Air-conditioning, refrigeration, and heating mechanics use a variety of tools. Hammers, wrenches, metal snips, electric drills, pipe cutters and benders, and acetylene torches and other tools are used to work with refrigerant lines and air ducts. Volt-ohmmeters, manometers, and other testing devices are used to check electrical circuits, burners, and other components.

Cooling and heating systems sometimes are installed or repaired by other craft workers. For example, on a large air-conditioning installation job, especially where workers are covered by union contracts, duct work might be done by sheet-metal workers; electrical work by electricians; and installation of piping, condensers, and other components by pipefitters.

Working Conditions

Mechanics work in homes, office buildings, factories--anywhere their is air-conditioning or heating equipment. They bring the tools and parts they need to the job sites. During the repair season, mechanics may do considerable driving. Radios may be used to dispatch them to the jobs. If major repairs are necessary, mechanics will transport broken machinery or parts to a repair shop.

Mechanics may work outside in cold or hot weather. The buildings that they work in may be uncomfortable because the air-conditioning or heating equipment is broken. Mechanics often work in awkward or cramped positions and sometimes are required to work in high places. Other hazards in this trade include electrical shock, torch burns, muscle strains, and other injuries from handling heavy equipment.

Places of Employment

Approximately 210,000 persons worked as air-conditioning, refrigeration, and heating mechanics in 1978. Cooling and heating contractors employed most air-conditioning and refrigeration mechanics and furnace installers. Fuel oil dealers employed most oil burner mechanics, and gas utility companies, most gas burner mechanics. Mechanics also work for foodstore chains, school systems, manufacturers, and other organizations that operate large air-conditioning, refrigeration, or heating systems. Approximately 1 out of 7 mechanics was self-employed.

Air-conditioning and refrigeration mechanics and furnace installers work in all parts of the country. Generally, the geographic distribution of these workers is similar to that of our population. Oil burner mechanics are concentrated in States where oil is a major heating fuel. Similarly, gas burner mechanics are concentrated in States where gas is a major heating fuel.

Training, Other Qualifications, and Advancement

Most air-conditioning, refrigeration, and heating mechanics start as helpers and acquire their skills by working for several years with experienced mechanics. New workers usually begin by assisting experienced mechanics and doing simple jobs. They may carry materials, insulate refrigerant lines, or clean furnaces. In time, they do more difficult jobs, such as cutting and soldering pipes and sheet metal and checking electrical circuits. In 4 to 5 years the new mechanics are capable of doing all types of repairs and installations.

Apprenticeship programs are run by unions and air-conditioning and heating contractors. In addition to on-the-job training, apprentices receive 144 hours of classroom instruction each year in related subjects, such as the use and care of tools, safety practices, blueprint reading, and air-conditioning theory. Applicants for apprenticeships must have a high school diploma and are given a mechanical aptitude test. Apprenticeships last 4 years.

Many high schools, private vocational schools, and junior colleges offer programs in air-conditioning and refrigeration. Students study air-conditioning and refrigeration theory and the design and construction of the equipment. They also learn the basics of installation, maintenance, and repair. Employers may prefer to hire graduates of these programs because they require less on-the-job training.

When hiring helpers, employers prefer high school graduates with mechanical aptitude who have had courses in mathematics, mechanical drawing, electricity, physics, and blueprint reading. Good physical condition also is necessary because workers sometimes have to lift and move heavy equipment.

To keep up with changes in technology and to expand their skills, experienced mechanics may take courses offered by associations such as the Refrigeration Service Engineers Society, the Petroleum Marketing Education Foundation, and the Air-Conditioning Contractors of America.

Mechanics can advance to positions as supervisors. Some open their own contracting businesses. However, it is becoming difficult for one-person operations to operate successfully.

Employment Outlook

Employment of air-conditioning, refrigeration, and heating mechanics is expected to increase about as fast as the average for all occupations through the 1980's. Many openings will occur as experienced mechanics transfer to other fields of work, retire, or die.

Opportunities for air-conditioning, heating, and refrigeration mechanics are expected to follow trends in residential and commercial construction. Even during periods of slow growth, many mechanics will be needed to service existing air-conditioning and heating systems. Installations of new energy-saving heating and air-conditioning systems also will cause employment of mechanics to grow. In addition, more refrigeration equipment will be needed in the production, storage, and marketing of food and other perishables. Because these trades have attracted many people, beginning mechanics may face competition for jobs as helpers or apprentices.

Sources of Additional Information

For more information about employment and training opportunities, contact the local office of the State employment service or firms that employ air-conditioning, refrigeration, and heating mechanics.

For pamphlets on career opportunities and training, write to:

Air-Conditioning and Refrigeration Institute,
1815 N. Fort Myer Dr., Arlington, VA 22209.
(The Institute prefers not to receive individual requests for large quantities of pamphlets.)

Air-Conditioning Contractors of America, 1228 17th
St. NW., Washington, DC 20036.

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*From Occupational Outlook Handbook, 1980-81

*OCCUPATIONAL EXIT POINTS FOR REFRIGERATION, HEATING, AND AIR CONDITIONING

637.261-010 WINDOW AIR CONDITIONING INSTALLER-SERVICER

Installs, services and repairs air-conditioning units ranging from 1/2 to 2 tons capacity, in private residences and small business establishments: Examines unit visually for defective parts or listens to machine in operation, utilizing knowledge of mechanical, electrical and refrigeration theory, to determine cause of malfunction. Dismantles whole or part of machine, as indicated by type of malfunction, and repairs or replaces such parts as switches, relays, fan motors, thermostats and other components, using handtools and power tools. Replaces filters, lubricates unit and adjusts controls. Reassembles machine, making necessary adjustments to insure efficient operation. May estimate cost of repairs or adjustments. May remove machines from customer's premises for major repairs or overhaul in shop, or for return to manufacturer for extensive repairs. May repair sealed refrigeration units of machines.

637.261-014 ENVIRONMENTAL CONTROL SYSTEM INSTALLER-SERVICER

Installs, services and repairs environmental-control systems in residences, department stores, office buildings and commercial establishments, utilizing knowledge of refrigeration theory, pipefitting and structural layout: Mounts compressor and condenser units on platform or floor using handtools, following blueprints or engineering specifications. Fabricates, assembles and installs ductwork and chassis parts, using portable metalworking tools and welding equipment. Installs evaporator unit in chassis or in air-duct system using handtools. Cuts and bends tubing to correct length and shape, using cutting and bending equipment and tools. Cuts and threads pipe using machine-threading or hand-threading equipment. Joins tubing or pipes to various refrigerating units by means of sleeves, couplings or unions, and solders joints, using torch, forming complete circuit for refrigerant. Installs expansion and discharge valves in circuit. Connects motors, compressors, temperature controls, humidity controls and circulating-ventilation fans to control panels and connects control panels to power source. Installs air and water filters in completed installation. Injects small amount of refrigerant into compressor to test systems and adds freon gas to build up prescribed operating pressure. Observes pressure and vacuum gauges and adjusts controls to insure proper operation. Tests joints and connections for gas leaks, using gauges or soap-and-water solution. Wraps pipes in insulation batting and secures them in place with cement or wire bands. Replaces defective breaker controls, thermostats, switches, fuses and electrical wiring to repair installed units, using electrician's handtools and test equipment. May install, repair and service air conditioners, ranging from fifteen to twenty tons cooling capacity, in warehouses and small factory buildings.

637.261-026 REFRIGERATION MECHANIC

Installs and repairs industrial and commercial refrigerating systems according to blueprints and engineering specifications, using knowledge of refrigeration, structural layout and function and design of components: Lays out reference points for installation of structural and functional components, using measuring instruments such as tape, transit, plumb bob, levels and square. Drills holes and installs mounting brackets and hangers into floor and walls of building. Lifts and aligns components into position, using hoist or block and tackle. Screws, bolts, rivets, welds and brazes parts to assemble structural and functional components such as motors, controls, switches, gauges, wiring harnesses, valves, pumps, compressors, condensers, cores and pipes. Cuts, threads and connects pipe to functional components and water or power system of premises. Pumps specified gas or fluid into system. Starts system, observes operation, reads gauges and instruments and adjusts mechanisms such as valves, controls and pumps to control level of fluid, pressure and temperature in system. Dismantles malfunctioning systems and tests components using electrical, mechanical and pneumatic testing equipment. Replaces or adjusts defective or worn parts to repair systems. May insulate shells and cabinets of systems. May install wiring to connect components to electric power source. May specialize in installing systems.

637.381-014 REFRIGERATION UNIT REPAIRER

Replaces defective components and reassembles refrigeration units to work orders and blueprint specifications: Studies rejection slips from inspection department or customer's letters and observes functioning of components such as controls, fan, condenser, evaporator or compressor to determine need for repair or replacement. Drains oil and pumps gas from unit. Loosens bolts and melts soldered or brazed seams to dismantle unit, using handtools and torch. Removes and replaces defective components. Brazes or solders parts to repair defective joints and leaks. Reassembles unit, using measuring instruments, handtools, soldering iron and hand torch. Routes defective components to salvage department. May adjust unit controls. Records cause of malfunction, repairs and replacements made.

637.664-010 ENVIRONMENTAL CONTROL SYSTEM INSTALLER-SERVICER HELPER

Assists workers engaged in installing, repairing and servicing industrial, commercial and residential environmental-control systems, performing any combination of following duties:

Cuts, punches, flanges, shears and solders sheet metal ducts and parts, using handtools and portable power tools. Cuts, threads and packs pipes. Cements insulation in place over finished piping or tubing. Passes electrical wire through conduit, splices wire connections and tapes wire. Assembles sheet metal components of prefabricated furnaces using handtools. Replaces exhausted or defective containers of refrigerant with new refrigerant. Lubricates fans, motors and control units. Installs air and water filters in completed assembly.

827.464-010 AIR CONDITIONING INSTALLER

Installs window-units or central-air-conditioning units in private residences and small business establishments: Inspects existing wiring, fuses or circuit-breaker panels on customer's premises to insure adequate power supply for operating air conditioner. Measures window, transom or other existing openings for air-conditioning unit, using measuring tape or rule, or cuts opening through wall using mallet and cold-chisel. Assembles and positions support brackets in place using screws, clamps or other braces, and handtools and power tools. Fills space between window support and edge of opening with calking compound and filler board. Places air conditioner on support frame and secures unit in position, leveling unit with screws, clips and bolts. Starts unit, adjusts controls and listens for excessive noise or sounds indicating malfunction. May give instructions to customer regarding operation and care of unit. May change filters, lubricate machine, replace fan motor or fan belt and make minor adjustments.

869.281-010 HOT AIR FURNACE INSTALLER AND REPAIRER

Installs and repairs hot-air furnaces, stoves and similar equipment in accordance with diagrams and other specifications using handtools and pipe-threading tools: Constructs foundation of concrete or other noncumbustible material. Assembles and positions heating units in accordance with diagrams using handtools. Cuts holes in floors and walls to form air-duct outlets. Installs air ducts, smoke pipes, blowers and stokers following blueprints of building and using handtools. Installs fuel pipes using dies, pipe cutters and pipe wrenches. Wraps insulating asbestos around air ducts. Connects and adjusts timers and thermostats. Inspects inoperative heating units to locate causes of trouble. Disassembles heating unit and replaces or repairs defective parts using handtools. Cuts, bends and crimps sheet metal to repair furnace and stove casing and pipes using crimpers, files, snips, handbrakes and sheet metal hammers. Reassembles and starts heating unit to test operation.

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*Dictionary of Occupational Titles, Fourth Edition, 1977.

EMPLOYABILITY SKILLS

In addition to the aptitudes, abilities, interests, physical requirements and job skills listed in the preceding Description of Occupation, employability skills exert a great deal of influence on a person's ability to get and keep a job. Surveys indicate that more people lose their jobs because of poor attitudes toward their job than for lack of job skills. For this reason it is important that information concerning the following employability skills be provided as an ongoing part of the program.

1. Getting a job
    a. Filling out job applications
    b. Developing a resume
    c. Preparing for a job interview

2. Keeping a job
    a. Be on time and regular in attendance
    b. Maintain a fair share of the work-load
    c. Work without supervision
    d. Meet production schedules
    e. Properly care for and use equipment
    f. Dress appropriately for the job
    g. Maintain good personal hygiene
    h. Develop and maintain good communication with supervisors and co-workers

A recent study sponsored by the Illinois Department of Adult, Vocational and Technical Education and conducted by the University of Illinois, "Survival Skills: Mastering the Human Aspects of Work", has identified twelve topics that might be developed into instructional modules for teaching occupational survival skills. The author, Robert E. Nelson, outlines these topics listed below and on the next page, each followed by a general objective which indicates the relationship between the topic and the survival skills required to maintain a job.

*"1. Working in an Organization: To familiarize students with the reasons for the formation of organizations and the common characteristics of organizations.
2. Understanding Self and Others: To have students develop insights into causes of human behavior and learn to interpret their own behavior and the behavior of others.
3. Motivation for Work: To have students develop an understanding of motivation for work and the ability to build positive motivations into the work they perform.

4. Interpersonal Relations: To have students develop concepts and skills in interpersonal relations and apply them to work situations.
5. On-the-Job Communication: To have students understand the importance of effective communication and learn ways of communicating effectively on the job.
6. Using Creativity on the Job: To make students aware of their creative potential and to practice using their creative ability in hypothetical on-the-job situations.
7. Authority and Responsibility: To have students develop an understanding of the concepts of authority, power, influence, and responsibility as they apply to work situations.
8. Problem Solving: To have students develop skill in applying problem solving to their work.
9. Coping with Organizational Change: To make students aware of the process of organizational change and the techniques for coping with organizational change.
10. Coping with Organizational Conflict: To make students aware of the sources and types of conflicts encountered on the job and recognize ways of coping with conflicts in an organization.
11. Leadership: To have students recognize the need for leadership in work groups and increase their understanding of the leadership role in work situations.
12. Adapting and Planning for the Future: To have students develop perspectives of work in the future and the ability to plan for anticipated changes in their work roles."

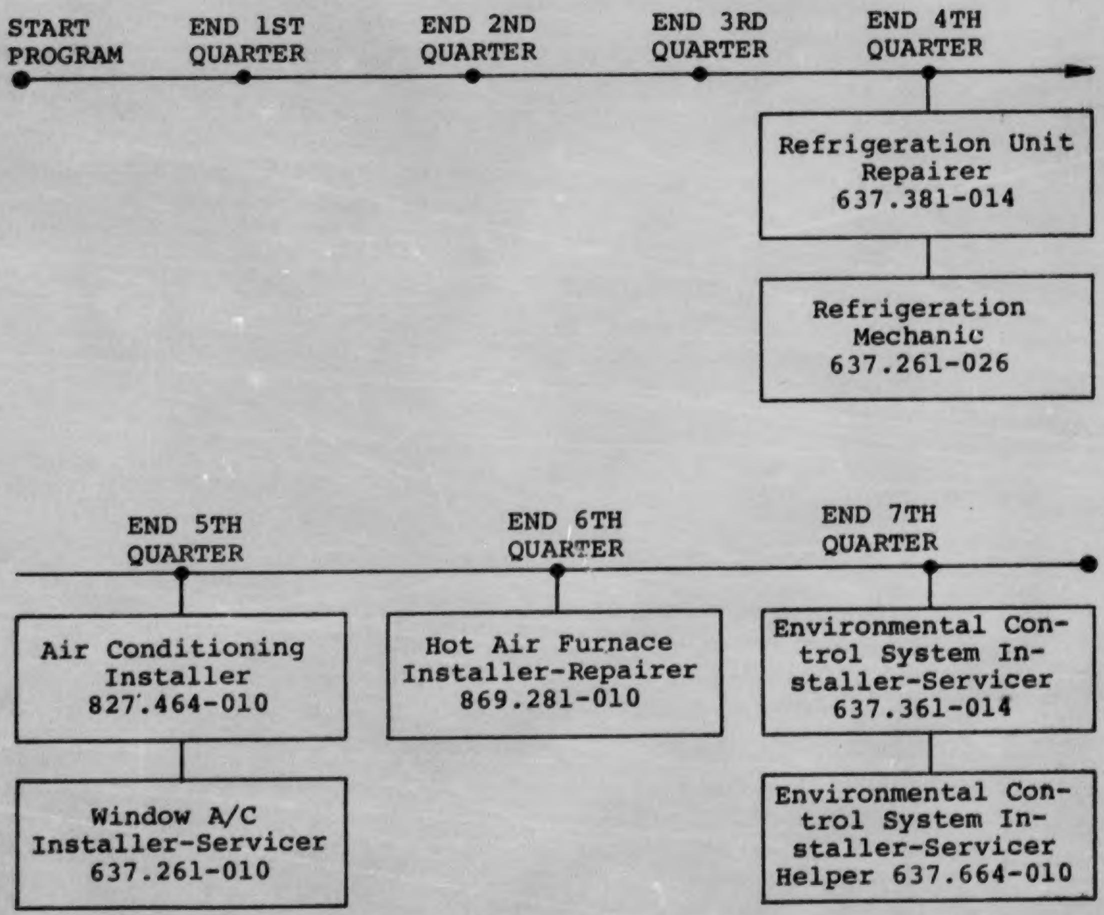
*Abstracted from the article, "Survival Skills: Mastering the Human Aspects of Work," by Robert E. Nelson, American Vocational Journal, November 1977.

EXIT POINTS BY QUARTER

The diagram on the following page, showing the occupational exit points by quarter, is based on the suggested Curriculum Structure (Alternative I) and the suggested Course Outline presented in this curriculum guide. It graphically illustrates the points in the Refrigeration, Heating and Air Conditioning program where the student should have acquired the competencies necessary for entry level employment into the job classifications indicated.

This diagram is based on only one sequence of teaching. The exit points may be rearranged by teaching the units in a different order. This flexibility allows the teacher to sequence the courses according to local preference. It also allows the curriculum to be individualized where individualization is preferred.

OCCUPATIONAL EXIT POINTS BY QUARTER FOR REFRIGERATION, HEATING AND AIR CONDITIONING


START PROGRAM
END 1ST QUARTER
END 2ND QUARTER
END 3RD QUARTER
END 4TH QUARTER
Refrigeration Unit Repairer 637.381-014
Refrigeration Mechanic 637.261-026
END 5TH QUARTER
END 6TH QUARTER
END 7TH QUARTER
Air Conditioning Installer 827.464-010
Window A/C Installer-Servicer 637.261-010
Hot Air Furnace Installer-Repairer 869.281-010
Environmental Control System Installer-Servicer 637.361-014
Environmental Control System Installer-Servicer Helper 637.664-010

TASK LISTING BY D.O.T. CODE

In this section the occupational exit points from the curriculum are cross referenced with the tasks which are required for employment in each job title. On the line following each task an x appears in the column of each job title to which the task applies. All the tasks listed in this matrix are taught in the curriculum presented in this guide. A detailed treatment of each task appears in the Unit Guides section of this curriculum guide.

TASK LISTING BY DOT CODE

REFRIGERATION, HEATING AND AIR CONDITIONING

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Refrigeration Mechanic	Refrigeration Unit Repairer	Window Air Conditioner Installer-Servicer	A/C Installer	Environmental Control System Installer-Servicer	Environmental Control Sys. Instal.-Serv. Helper	Hot Air Furnace Installer-Repairer	
	DOT DESCRIPTIONS / DOT NO.	637.261-026	637.381-014	637.261-010	827.464-010	637.261-014	637.664-010	869.281-010	
	ELECTRICITY								
EL-01	Using basic electrical theory	X	X	X	X	X	X	X	
EL-02	Computing Ohm's law and power formulas	X	X	X	X	X	X	X	
EL-03	Using electric meters	X	X	X	X	X	X	X	
EL-04	Understanding series and parallel circuits	X	X	X	X	X	X	X	
EL-05	Identifying electric symbols	X	X	X	X	X	X	X	
EL-06	Reading basic schematic diagrams	X	X	X	X	X	X	X	
EL-07	Reading advanced schematic diagrams	X	X	X	X	X	X	X	
EL-08	Applying alternating current principles	X	X	X	X	X	X	X	
EL-09	Determining and selecting wire size and making connections	X	X	X	X	X	X	X	
EL-10	Making main panel connections	X	X	X	X	X	X	X	
EL-11	Servicing shaded pole motors	X	X	X		X		X	
EL-12	Wiring split-phase motors	X	X	X		X		X	
EL-13	Checking capacitors	X	X	X		X		X	
EL-14	Hooking up and troubleshooting PSC motors	X	X	X		X		X	
EL-15	Hooking up and troubleshooting CS motors	X	X	X		X		X	
EL-16	Hooking up and troubleshooting CSR motors	X	X	X		X		X	
EL-17	Connecting three phase motors	X	X	X		X		X	
EL-18	Testing motors	X	X	X		X		X	
EL-19	Maintaining electric motors	X	X	X		X		X	
EL-20	Installing and testing transformers	X	X	X		X		X	

TASK LISTING BY DOT CODE

REFRIGERATION, HEATING AND AIR CONDITIONING

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	Refrigeration Mechanic	Refrigeration Unit Repairer	Window Air Conditioner Installer-Servicer	A/C Installer	Environmental Control System Installer-Servicer	Environmental Control Sys. Instal.-Serv. Helper	Hot Air Furnace Installer-Repairer	
	DOT NO.	637.261-026	637.381-014	637.261-010	827.464-010	637.261-014	637.664-010	869.281-010	
EL-21	Installing and testing contactors and relays	X	X	X		X		X	
EL-22	Installing and checking thermostats	X	X	X		X		X	
EL-23	Installing and checking pressure switches	X	X	X		X		X	
EL-24	Troubleshooting overload devices	X	X	X		X		X	
EL-25	Installing and checking various electric								
	control devices	X	X	X		X		X	
EL-26	Troubleshooting magnetic starters	X	X	X		X		X	
EL-27	Wiring packaged air conditioners	X	X	X		X			
EL-28	Wiring split system air conditioning units	X	X	X		X			
EL-29	Designing a control panel	X	X	X		X		X	
EL-30	Designing an advanced control panel	X	X	X		X		X	
EL-31	Troubleshooting a basic electrical control								
	system	X	X	X		X		X	
EL-32	Advanced troubleshooting of electrical control								
	systems	X	X	X		X		X	
EL-33	Servicing solid-state control circuits	X	X	X		X		X	
	REFRIGERATION								
RF-01	Becoming familiar with career opportunities in								
	refrigeration	X	X	X		X	X		
RF-02	Identifying safe working conditions	X	X	X		X	X		

TASK LISTING BY DOT CODE

REFRIGERATION, HEATING AND AIR CONDITIONING

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	DOT DESCRIPTIONS DOT NO.	Refrigeration Mechanic 637.261-026	Refrigeration Unit Repairer 637.381-014	Window Air Conditioner Installer-Servicer 637.261-010	A/C Installer 827.464-010	Environmental Control System Installer-Servicer 637.261-014	Environmental Control Sys. Instal.-Serv. Helper 637.664-010	Hot Air Furnace Installer-Repairer 869.281-010	
RF-03	Demonstrating a knowledge of the basic refrigeration concepts		X	X	X		X	X		
RF-04	Demonstrating knowledge of the basic refrigeration cycle		X	X	X		X	X		
RF-05	Using refrigeration tools		X	X	X		X	X		
RF-06	Tapping, threading and replacing threads		X	X	X		X	X		
RF-07	Becoming familiar with fitting nomenclature and pipe materials		X	X	X		X	X		
RF-08	Performing basic copper tubing operations		X	X	X		X	X		
RF-09	Soft soldering copper tubing		X	X	X		X	X		
RF-10	Silver brazing		X	X	X		X	X		
RF-11	Handling refrigerants		X	X	X		X	X		
RF-12	Installing and using access valves		X	X	X		X	X		
RF-13	Maintaining refrigeration manifold gauges		X	X	X		X	X		
RF-14	Installing and using refrigeration manifold gauges		X	X	X		X	X		
RF-15	Evacuating a refrigeration system		X	X	X		X	X		
RF-16	Installing refrigeration accessories		X	X	X		X			
RF-17	Testing for leaks		X	X	X		X	X		
RF-18	Charging the system		X	X	X		X	X		
RF-19	Testing the compressor		X	X	X		X			
RF-20	Troubleshooting condensers		X	X	X		X			

TASK LISTING BY DOT CODE

REFRIGERATION, HEATING AND AIR CONDITIONING

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	DOT DESCRIPTIONS: Refrigeration Mechanic DOT NO.: 637.261-026	Refrigeration Unit Repairer 637.381-014	Window Air Conditioner Installer-Servicer 637.261-010	A/C Installer 827.464-010	Environmental Control System Installer-Servicer 637.261-014	Environmental Control Sys. Instal.-Serv. Helper 637.664-010	Hot Air Furnace Installer-Repairer 869.281-010	
RF-21	Troubleshooting evaporators	X	X	X		X			
RF-22	Troubleshooting an automatic expansion valve	X	X	X		X			
RF-23	Troubleshooting capillary tubes	X	X	X		X			
RF-24	Troubleshooting thermostatic expansion valves	X	X	X		X			
RF-25	Troubleshooting the refrigeration system	X	X	X		X			
	AIR CONDITIONING								
AC-01	Identifying major components and functions of air conditioning systems			X		X	X		
AC-02	Applying basic air principles			X		X	X		
AC-03	Calculating heat loads			X		X			
AC-04	Applying principles of air movement			X		X	X		
AC-05	Servicing air filtering systems			X	X	X	X		
AC-06	Installing a window air conditioning unit			X	X	X	X		
AC-07	Performing pre-season start up maintenance on window air conditioning units			X		X	X		
AC-08	Troubleshooting compressor burnout in window air conditioners			X		X			
AC-09	Evacuating and charging window air conditioners			X		X	X		
AC-10	Troubleshooting fans and fan motors			X		X			
AC-11	Troubleshooting mechanical problems in window air conditioner refrigeration cycle			X		X			

TASK LISTING BY DOT CODE

REFRIGERATION, HEATING AND AIR CONDITIONING

POSSIBLE EXIT POINTS

	DOT DESCRIPTIONS	Refrigeration Mechanic	Refrigeration Unit Repairer	Window Air Conditioner Installer-Servicer	A/C Installer	Environmental Control System Installer-Servicer	Environmental Control Sys. Instal.-Serv. Helper	Hot Air Furnace Installer-Repairer	
	DOT NO.	637.261-026	637.381-014	637.261-010	827.464-010	637.261-014	637.664-010	869.281-010	
TASK NO.	TASK NAME								
AC-12	Troubleshooting a window air conditioner electrical system			X		X			
AC-13	Installing condensate drains				X	X	X		
AC-14	Installing residential and mobile home package air conditioning units				X	X	X		
AC-15	Installing split system air conditioning units				X	X	X		
AC-16	Installing add-on split air conditioning systems				X	X	X		
AC-17	Troubleshooting compressor burnout					X			
AC-18	Troubleshooting fans and fan motors					X			
AC-19	Performing pre-season start up air conditioning service					X	X		
AC-20	Troubleshooting air conditioner refrigeration cycle					X			
AC-21	Troubleshooting air conditioner electrical cycle					X			
AC-22	Troubleshooting air conditioner air movement					X			
	HEAT PUMPS								
AC-23	Applying principles of the heat pump					X	X		
AC-24	Evacuating and charging the heat pump					X	X		
AC-25	Installing a reversing valve					X			

TASK LISTING BY DOT CODE

REFRIGERATION, HEATING AND AIR CONDITIONING

POSSIBLE EXIT POINTS

	DOT DESCRIPTIONS	Refrigeration Mechanic	Refrigeration Unit Repairer	Window Air Conditioner Installer-Servicer	A/C Installer	Environmental Control System Installer-Servicer	Environmental Control Sys. Instal.-Serv. Helper	Hot Air Furnace Installer-Repairer	
	DOT NO.	637.261-026	637.381-014	637.261-010	827.464-010	637.261-014	637.664-010	869.281-010	
TASK NO.	TASK NAME								
AC-26	Tracing the heat pump refrigeration cycle					X			
AC-27	Installing electrical circuits				X	X			
AC-28	Adjusting and repairing defrost controls					X			
AC-29	Installing package heat pumps				X	X	X		
AC-30	Installing split-system heat pumps				X	X	X		
	HEATING								
HE-01	Applying principles of electric furnaces and controls					X	X	X	
HE-02	Installing electric furnaces					X	X	X	
HE-03	Troubleshooting electric furnaces					X		X	
HE-04	Applying gas fuel combustion and safety principles					X	X	X	
HE-05	Identifying major components and functions of gas heating systems					X	X	X	
HE-06	Checking gas sources					X	X	X	
HE-07	Applying gas piping principles					X	X	X	
HE-08	Installing and adjusting gas regulators					X		X	
HE-09	Installing and servicing gas valves					X		X	
HE-10	Installing and servicing pilot ignition devices					X		X	
HE-11	Installing and servicing combination gas valves					X		X	
HE-12	Servicing gas burners					X		X	

TASK LISTING BY DOT CODE

REFRIGERATION, HEATING AND AIR CONDITIONING

		POSSIBLE EXIT POINTS							
	DOT DESCRIPTIONS	Refrigeration Mechanic	Refrigeration Unit Repairer	Window Air Conditioner Installer-Servicer	A/C Installer	Environmental Control System Installer-Servicer	Environmental Control Sys. Instal-Serv. Helper	Hot Air Furnace Installer-Repairer	
TASK NO.	**TASK NAME** / DOT NO.	637.261-026	637.381-014	637.261-010	827.464-010	637.261-014	637.664-010	869.281-010	
HE-13	Inspecting and adjusting temperature rise of heat exchangers					X		X	
HE-14	Venting gas heating systems					X	X	X	
HE-15	Servicing gas furnace electrical controls					X		X	
HE-16	Determining combustion efficiency					X		X	
HE-17	Performing a pre-season check-up and start-up on a gas furnace					X		X	
HE-18	Troubleshooting the gas heating system					X		X	
HE-19	Identifying types of fuel oil and principles of combustion					X		X	
HE-20	Designing and installing oil piping					X	X	X	
HE-21	Installing oil burners					X		X	
HE-22	Installing and servicing transformers and electrodes					X		X	
HE-23	Installing oil pumps					X		X	
HE-24	Servicing blower, nozzle, motor and coupling					X		X	
HE-25	Performing the combustion efficiency test					X		X	
HE-26	Installing controls					X		X	
HE-27	Performing pre-season start-up and check-up on an oil burning heating system					X		X	
HE-28	Troubleshooting the oil burning heating system					X		X	

TASK LISTING BY DOT CODE

REFRIGERATION, HEATING AND AIR CONDITIONING

POSSIBLE EXIT POINTS

	DOT DESCRIPTIONS	Refrigeration Mechanic	Refrigeration Unit Repairer	Window Air Conditioner Installer-Servicer	A/C Installer	Environmental Control System Installer-Servicer	Environmental Control Sys. Instal.-Serv. Helper	Hot Air Furnace Installer-Repairer	
	DOT NO.	637.261-026	637.381-014	637.261-010	827.464-010	637.261-014	637.664-010	869.281-010	
TASK NO.	TASK NAME								
	SHEET METAL								
SM-01	Identifying materials used in sheet metalwork				X	X	X	X	
SM-02	Developing sheet metal patterns (stretchouts)				X	X	X	X	
SM-03	Cutting sheet metal				X	X	X	X	
SM-04	Bending sheet metal by hand				X	X	X	X	
SM-05	Bending metal on a bar folder or brake				X	X	X	X	
SM-06	Roll-forming sheet metal				X	X	X	X	
SM-07	Making seams				X	X	X	X	
SM-08	Using the rotary machine				X	X	X	X	
SM-09	Fastening sheet metal				X	X	X	X	
SM-10	Cutting and welding sheet metal using oxyacetylene equipment				X	X	X	X	
SM-11	Welding sheet metal using metal arc welding equipment				X	X	X	X	
SM-12	Soldering sheet metal				X	X	X	X	

TASK LISTING BY DOT CODE

REFRIGERATION,
HEATING AND AIR CONDITIONING

	POSSIBLE EXIT POINTS DOT DESCRIPTIONS	Refrigeration Mechanic	Refrigeration Unit Repairer	Window Air Conditioner Installer-Servicer	A/C Installer	Environmental Control System Installer-Servicer	Environmental Control Sys. Instal-Serv. Helper	Hot Air Furnace Installer-Repairer	
	DOT NO.	637.261-026	637.381-014	637.261-010	827.464-010	637.261-014	637.664-010	869.281-010	
TASK NO.	TASK NAME								
	SOLAR ENERGY								
SE-01	Demonstrating knowledge of the basic principles of solar energy and solar radiation					X	X		
SE-02	Identifying basic solar system components and their uses					X	X		
SE-03	Conducting an energy audit of a residence					X			
SE-04	Selecting passive solar approaches for new construction					X			
SE-05	Selecting solar collectors					X			
SE-06	Selecting and siting thermal storage units					X			
SE-07	Selecting control devices					X			
SE-08	Identifying and describing modes of solar system operation					X			
SE-09	Calculating heat load for space or domestic hot water heating					X			
SE-10	Sizing solar system components					X			
SE-11	Performing a solar system economic analysis					X			
SE-12	Selecting a domestic solar hot water system					X			
SE-13	Selecting/fabricating correct thermal mass for a direct gain solar system					X			
SE-14	Integrating installation of a solar system in a construction schedule					X			

TASK LISTING BY DOT CODE

REFRIGERATION,
HEATING AND AIR CONDITIONING

POSSIBLE EXIT POINTS

TASK NO.	TASK NAME	DOT DESCRIPTIONS / DOT NO.	Refrigeration Mechanic 637.261-026	Refrigeration Unit Repairer 637.381-014	Window Air Conditioner Installer-Servicer 637.261-010	A/C Installer 827.464-010	Environmental Control System Installer-Servicer 637.261-014	Environmental Control Sys. Instal-Serv. Helper 637.664-010	Hot Air Furnace Installer-Repairer 869.281-010	
SE-15	Installing liquid storage tanks						X	X		
SE-16	Siting and mounting collectors						X	X		
SE-17	Installing liquid collectors and outside plumbing						X	X		
SE-18	Installing inside plumbing for collector load-side loops						X	X		
SE-19	Installing controls and wiring						X	X		
SE-20	Filling and starting the system						X	X		
SE-21	Maintaining a solar system						X	X		
SE-22	Troubleshooting solar system problems						X	X		

SECTION IV

CURRICULUM STRUCTURE & COURSE OUTLINE

CURRICULUM STRUCTURE

The following examples of curriculum structures are provided to illustrate the different ways a Refrigeration, Heating and Air Conditioning Program can be structured. The examples are not intended to imply there are not other ways to structure the curriculum.

Alternatives I and II are examples of programs within Georgia. The time estimates of each alternative vary according to local program objectives. The actual amount of time required for each course will depend upon the instructor, the students and facilities available.

Each instructor is encouraged to structure the curriculum and make time estimates based on experience, industry requirements, students' needs and the local facilities (classroom, equipment, lab) available.

REFRIGERATION, HEATING AND AIR CONDITIONING CURRICULUM STRUCTURE

Alternative I

Course Number	Course Title	Clock Hours
	First Quarter	
	Shop Math	84
	Basic Electricity	228
		312
	Second Quarter	
	Electric Motors	140
	Basic Refrigeration Concepts	58
	Welding for Electro-Mechanics	114
		312
	Third Quarter	
	Electrical Troubleshooting and Controls	237
	Refrigeration Tools and Tubing	75
		312
	Fourth Quarter	
	Evacuating and Charging Refrigeration Systems	75
	Troubleshooting Refrigeration Systems	159
	Basic Air Conditioning	78
		312
	Fifth Quarter	
	Window Air Conditioning	93
	Central, Split and Add-On A/C	48
	Troubleshooting Air Conditioning Systems	75
	Electric Furnaces	48
	Sheet Metal Practices	48
		312

Course Number	Course Title	Clock Hours
	Sixth Quarter	
	Heat Pumps	78
	Gas Heating	138
	Oil Heating	96
		312
	Seventh Quarter	
	Solar Energy	312
	Eighth Quarter	
	Practicum	312

REFRIGERATION, HEATING AND AIR CONDITIONING
CURRICULUM STRUCTURE

Alternative II

Course Number	Course Title	Clock Hours
	First Quarter	
	Shop Math	52
	Basic Refrigeration Theory	52
	Principles and Practices of Refrigeration	104
	Refrigeration Cycle Components	52
	Domestic Refrigeration	52
		312
	Second Quarter	
	Communication Skills	52
	Basic Electricity	104
	Electric Motors and Electric Circuit Controls	104
	Air Conditioning Fundamentals	52
		312
	Third Quarter	
	Residential Air Conditioning	52
	Air Conditioning Systems Clean-Up and Repair	52
	Heat Pumps	104
	Commercial Refrigeration	104
		312

Course Number	Course Title	Clock Hours
	Fourth Quarter	
	Basic Principles of Solar Energy	52
	Solar System Components	104
	Solar System Design	52
	Solar System Installation Maintenance and Repair	104
		312
	Fifth Quarter	
	Fundamentals of Heating with Natural Gas and Oil	104
	Gas Piping	52
	Control Wiring	104
	Consumer Education	52
		312
	Sixth Quarter	
	Georgia Warm Air Heating Code	156
	Human Relations	52
	Commercial Air Conditioning	104
		312
	Seventh Quarter	
	Fundamentals of Air Conditioning Airways and Devices	104
	Special Controls	104
	Job Plans and Specifications For Cooling and Heating Layouts	104
		312
	Eighth Quarter	
	On/Off Campus Practicum in Air Conditioning and Refrigeration	312
	TOTAL:	2,496

REFRIGERATION, HEATING AND AIR CONDITIONING
CURRICULUM STRUCTURE

Alternative III

Course Number	Course Title	Clock Hours
	First Quarter	
	Orientation and Shop Safety	12
	Basic Mathematics	52
	Communication Skills	52
	Basic Refrigeration Theory	52
	Principles and Practices Refrigeration	144
		312
	Second Quarter	
	Refrigeration System Components	104
	Basic Oxycetylene Welding	52
	Electric Meters	52
	Reading Schematic Diagrams	104
		312
	Third Quarter	
	Electric Motors	156
	Electrical Components in Air Conditioning	156
		312
	Fourth Quarter	
	Air Conditioning Control Systems	156
	Electrical Troubleshooting	156
		312
	Fifth Quarter	
	Principles of Air Conditioning	208
	Basic Blueprint Reading	104
		312

Course Number	Course Title	Clock Hours
	Sixth Quarter	
	Air Conditioning Clean-Up and Repair	104
	Heat Pumps	208
		312
	Seventh Quarter	
	Residential Air Conditioning	208
	Load Calculation and Equipment Selection	104
		312
	Eighth Quarter	
	Heating with Gas	104
	Heating with Oil	104
	Gas Piping and Venting	104
		312

SUGGESTED COURSE OUTLINE FOR REFRIGERATION, HEATING AND AIR CONDITIONING

The course outline presented in this section represents one suggested order for teaching the tasks that will qualify the student for employment in the occupational job titles that have been specified. This is not the only acceptable order for teaching the tasks. Therefore, the instructor should use whatever degree of latitude is desirable in designing the local curriculum, so long as the prerequisites to some tasks are recognized and so long as specific occupational exit points are the end product.

This flexibility of sequence is an aid in designing separate courses and is also well suited for designing course content for individual students.

Suggested Course Outline For

Refrigeration, Heating and Air Conditioning

First Quarter

Unit	Title	Clock Hours
	Course Title: Basic Electricity	
EL-01	Using basic electrical theory	9
EL-02	Computing Ohm's law and power formulas	15
EL-03	Using electric meters	18
EL-04	Understanding series and parallel circuits	18
EL-05	Identifying electric symbols	24
EL-06	Reading basic schematic diagrams	48
EL-07	Reading advanced schematic diagrams	48
EL-08	Applying alternating current principles	15
EL-09	Determining and selecting wire size and making connections	18
EL-10	Making main panel connections	15
	Total Course Hours:	228
	Course Title: Shop Math	
	Total Course Hours	84
	Total Quarter Hours	312

Second Quarter

Unit	Title	Clock Hours
	Course Title: Electric Motors	
EL-11	Servicing shaded pole motors	9
EL-12	Wiring split-phase motors	21
EL-13	Checking capacitors	9
EL-14	Hooking up and troublehsooting PSC motors	24
EL-15	Hooking up and troubleshooting CS motors	36
EL-16	Hooking up and troubleshooting CSR motors	9
EL-17	Connecting three phase motors	9
EL-18	Testing motors	14
EL-19	Maintaining electric motors	9
	Total Course Hours:	140
	Course Title: Basic Refrigeration Concepts	
RF-01	Becoming familiar with career opportunities in refrigeration	6
RF-02	Identifying safe working conditions	6
RF-03	Demonstrating a knowledge of the basic refrigeration concepts	20
RF-04	Demonstrating knowledge of the basic refrigeration cycle	24
	Total Course Hours:	56
	Course Title: Welding for Electro-Mechanics	
SM-01	Identifying materials used in sheet metalwork	4
SM-10	Cutting and welding sheet metal using oxyacetylene equipment	52
SM-11	Welding sheet metal using metal arc welding equipment	40
SM-12	Soldering sheet metal	18
	Total Course Hours:	114
	Total Quarter Hours:	310

Third Quarter

Unit	Title	Clock Hours
	Course Title: Electrical Troubleshooting and Controls	
EL-20	Installing and testing transformers	12
EL-21	Installing and testing contactors and relays	12
EL-22	Installing and checking thermostats	30
EL-23	Installing and checking pressure switches	18
EL-24	Troubleshooting overload devices	18
EL-25	Installing and checking various electric control devices	12
EL-26	Troubleshooting magnetic starters	30
EL-27	Wiring packaged air conditioners	6
EL-28	Wiring split system air conditioning units	9
EL-29	Designing a control panel	18
EL-30	Designing an advanced control panel	18
EL-31	Troubleshooting a basic electrical control system	18
EL-32	Advanced troubleshooting of electrical control systems	18
EL-33	Servicing solid-state control circuits	18
	Total Course Hours:	237
	Course Title: Refrigeration Tools and Tubing	
RF-05	Using refrigeration tools	12
RF-06	Tapping, threading and replacing threads	6
RF-07	Becoming familiar with fitting nomenclature and pipe materials	9
RF-08	Performing basic copper tubing operations	12
RF-09	Soft soldering copper tubing	18
RF-10	Silver brazing	18
	Total Course Hours:	75
	Total Quarter Hours:	312

Fourth Quarter

Unit	Title	Clock Hours
	Course Title: Evacuating and Charging Refrigeration Systems	
RF-11	Handling refrigerants	10
RF-12	Installing and using access valves	8
RF-13	Maintaining refrigeration manifold guages	4
RF-14	Installing and using refrigeration manifold gauges	11
RF-15	Evacuating a refrigeration system	12
RF-16	Installing refrigeration accessories	6
RF-17	Testing for leaks	6
RF-18	Charging the system	18
	Total Course Hours:	75
	Course Title: Troubleshooting Refrigeration Systems	
RF-19	Testing the compressor	30
RF-20	Troubleshooting condensers	15
RF-21	Troubleshooting evaporators	15
RF-22	Troubleshooting an automatic expansion valve	18
RF-23	Troubleshooting capillary tubes	24
RF-24	Troubleshooting thermostatic expansion valves	9
RF-25	Troubleshooting the refrigeration system	48
	Total Course Hours:	159
	Course Title: Basic Air Conditioning	
AC-01	Identifying major components and functions of air conditioning systems	10
AC-02	Applying basic air principles	10
AC-03	Calculating heat loads	28
AC-04	Applying principles of air movement	15
AC-05	Servicing air filtering systems	15
	Total Course Hours:	78
	Total Quarter Hours:	312

Exit Point: Refrigeration Unit Repairer
D.O.T. 637.381-014

Refrigeration Mechanic
D.O.T. 637.261-026

Fifth Quarter

Unit	Title	Clock Hours
	Course Title: Window Air Conditioning	
AC-06	Installing a window air conditioning unit	6
AC-07	Performing pre-season start-up maintenance or window air conditioning units	6
AC-08	Troubleshooting compressor burnout in window air conditioners	18
AC-09	Evacuating and charging window air conditioners	18
AC-10	Troubleshooting fans and fan motors	9
AC-11	Troubleshooting mechanical problems in window air conditioner refrigeration cycle	18
AC-12	Troubleshooting a window air conditioner electrical system	18
	Total Course Hours:	93
	Course Title: Central, Split and Add-On Air Conditioning	
AC-13	Installing condensate drains	6
AC-14	Installing residential and mobile home package air conditioning units	6
AC-15	Installing split system air conditioning units	18
AC-16	Installing add-on split air conditioning systems	18
	Total Course Hours:	48
	Course Title: Troubleshooting Air Conditioning Systems	
AC-17	Troubleshooting compressor burnout	18
AC-18	Troubleshooting fans and fan motors	9
AC-19	Performing pre-season start-up air conditioning service	6
AC-20	Troubleshooting air conditioner refrigeration cycle	12
AC-21	Troubleshooting air conditioner electrical cycle	18
AC-22	Troubleshooting air conditioner air movement	12
	Total Course Hours:	75

Unit	Title	Clock Hours
	Course Title: Electric Furnaces	
HE-01	Applying principles of electric furnaces and controls	18
HE-02	Installing electric furnaces	12
HE-03	Troubleshooting electric furnaces	18
	Total Course Hours:	48
	Course Title: Sheet Metal Practices	
SM-02	Developing sheet metal patterns (stretchouts)	6
SM-03	Cutting sheet metal	6
SM-04	Bending sheet metal by hand	6
SM-05	Bending metal on a bar folder or brake	6
SM-06	Roll-forming sheet metal	6
SM-07	Making seams	6
SM-08	Using the rotary machine	6
SM-09	Fastening sheet metal	6
	Total Course Hours	48
	Total Quarter Hours:	312

Exit Points: Air Conditioning Installer
D.O.T. 827.464-010

Window Air Conditioning
Installer-Servicer
D.O.T. 637.261-010

Sixth Quarter

Unit	Title	Clock Hours
	Course Title: Heat Pumps	
AC-23	Applying principles of the heat pump	12
AC-24	Evacuating and charging the heat pump	12
AC-25	Installing a reversing valve	6
AC-26	Tracing the heat pump refrigeration cycle	12
AC-27	Installing electrical circuits	12
AC-28	Adjusting and repairing defrost controls	6
AC-29	Installing package heat pumps	9
AC-30	Installing split-system heat pumps	9
	Total Course Hours:	78
	Course Title: Gas Heating	
HE-04	Applying gas fuel combustion and safety principles	9
HE-05	Identifying major components and functions of gas heating systems	6
HE-06	Checking gas sources	6
HE-07	Applying gas piping principles	18
HE-08	Installing and adjusting gas regulators	6
HE-09	Installing and servicing gas valves	6
HE-10	Installing and servicing pilot ignition devices	12
HE-11	Installing and servicing combination gas valves	6
HE-12	Servicing gas burners	12
HE-13	Inspecting and adjusting temperature rise of heat exchangers	6
HE-14	Venting gas heating systems	12
HE-15	Servicing gas furnace electrical controls	12
HE-16	Determing combustion efficiency	9
HE-17	Performing a pre-season check-up and start-up on a gas furnace	6
HE-18	Troubleshooting the gas heating system	12
	Total Course Hours:	138
	Course Title: Oil Heating	
HE-19	Identifying types of fuel oil and principles of combustion	6
HE-20	Designing and installing oil piping	12
HE-21	Installing oil burners	12
HE-22	Installing and servicing tranformers and electrodes	6
HE-23	Installing oil pumps	6
HE-24	Servicing blower, nozzle, motor and coupling	6

Unit	Title	Clock Hours
	Course Title: Oil Heating (Continued)	
HE-25	Performing the combustion efficiency test	12
HE-26	Installing controls	18
HE-27	Performing pre-season start-up and check-up on an oil burning heating system	6
HE-28	Troubleshooting the oil burning heating system	12
	Total Course Hours:	96
	Total Quarter Houts:	312

Exit Point: Hot Air Furnace
Installer and Repairer
869.281-010

Seventh Quarter

Unit	Title	Clock Hours
	Course Title: Solar Energy	
	Major Block: Principles of Solar Energy	
SE-01	Demonstrating knowledge of the basic principles of solar energy and solar radiation	18
SE-02	Identifying basic solar system components and their uses	24
	Major Block: Solar System Design	
SE-03	Conducting an energy audit of a residence	9
SE-04	Selecting passive solar approaches for new construction	9
SE-05	Selecting solar collectors	6
SE-06	Selecting and siting thermal storage units	9
SE-07	Selecting control devices	9
SE-08	Identifying and describing modes of solar system operation	6
SE-09	Calculating heat load for space or domestic hot water heating	9
SE-10	Sizing solar system components	6
SE-11	Performing a solar system economic analysis	12
SE-12	Selecting a domestic solar hot water system	6
	Major Block: Solar Installation	
SE-13	Selecting/fabricating correct thermal mass for a direct gain solar system	12
SE-14	Integrating installation of a solar system in a construction schedule	6
SE-15	Installing liquid storage tanks	12
SE-16	Siting and mounting collectors	18
SE-17	Installing liquid collectors and outside plumbing	18
SE-18	Installing inside plumbing for collector load-side loops	18
SE-19	Installing controls and wiring	24
SE-20	Filling and starting the system	9
	Major Block: Solar Maintenance	
SE-21	Maintaining a solar system	30
SE-22	Troubleshooting solar system problems	40
	Total Course Hours	310
	Total Quarter Hours:	310

Course Title: Solar Energy (Continued)

Exit Point: Environmental Control System
Installer-Servicer D.O.T. 637.361-014

Environmental Control System
Installer-Servicer Helper
D.O.T. 637.664-010

Eighth Quarter

Unit	Title	Clock Hours
	Course Title: Practicum	
	Work Experience	312
	Total Course Hours:	312
	Total Quarter Hours:	312

SECTION V

UNIT GUIDES

Description

In this section the tasks to be taught in each course are presented in sequential order. Each task is listed on a separate page so that it may be taken out of the guide for daily lesson planning or regrouped with other tasks to fit the individual teacher's own preference for teaching order. The task pages may be used for planning and executing group instruction or for individualized instruction. Each page in the UNIT GUIDES section contains the following information:

TASK: This is a short and concise statement of the task to be taught.

PERFORMANCE OBJECTIVE: The performance expected of the student after completing the unit is stated in stem form, without a specific statement of all conditions, equipment and performance standard (these are listed in a criterion referenced measure in the Evaluation section of the task page).

INSTRUCTIONAL ACTIVITIES: Suggested learning activities are presented. These activities include providing information, demonstrating use of audio visuals and practical applications.

INSTRUCTIONAL MATERIALS: The materials that are necessary to carry out the instructional activities are listed. These include textbooks, audio visuals and equipment.

EVALUATION: This section contains a criterion referenced measure (where appropriate) and reference to any test items or other evaluation measures that are available to the teacher. The criterion referenced measure contains three parts--Condition, Performance and Standard.

CLASSROOM HOURS: This figure represents the total hours estimated for all instructional activities and evaluation necessary to teach the task, including shop or laboratory time for student practical application activities.

TASK

EL-01 Using basic electrical theory

PERFORMANCE OBJECTIVE

Demonstrate an understanding of basic electrical theory.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Atoms
    1. Nucleus
    2. Protons
    3. Neutrons
    4. Electrons
    5. Orbits
    6. Free electrons
    7. Flow of electrons
b. Law of electrical charges
c. Production of electricity
    1. Static
    2. Chemical
    3. Generator
d. Conductors
e. Insulators
f. Electromotive force
g. Current
h. Resistance
i. Electric circuit
j. Volts
k. Amperage
l. Ohms
m. Watts
n. Electrical Safety

Provide Demonstration On:

a. Composition of an Atom
b. Loss and gain of electrons
c. Safety and first aid procedures

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-01, "Understanding Basic Electrical Theory"

Student Manuals:

Georgia, Electricity, Unit EL-01

CLASSROOM HOURS 9

EVALUATION (EL-01)

a. The student will correctly identify the parts of an atom on a diagram and will match electrical terms with their proper definitions.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-02 Computing Ohm's law and power formulas

PERFORMANCE OBJECTIVE

Compute calculations using Ohm's law and power formula.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Ohm's law
b. Function and use of Ohm's law
c. Power formulas
d. Function and use of power formulas
e. Relationship of Ohm's law and power formulas

Provide Demonstration On:

Problems using Ohm's law and power formulas

Provide Practical Application On:

Calculating additional information on electrical equipment using Ohm's law and power formulas from information on the data plate of the equipment

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

Student Manuals:

Georgia, Electricity, Unit EL-02

Tools and Equipment:

Electrical tools and equipment with a data plate

CLASSROOM HOURS 15

EVALUATION (EL-02)

a. Given a set of problems involving unknown values of current, voltage, resistance and power, the student will correctly solve for unknown values using Ohm's law and power formulas.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-03 Using electric meters

PERFORMANCE OBJECTIVE

Read voltage, amperage, and ohms using various electric meters.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of ammeters
b. Function of electric meters
c. Reading meters
d. Using data plate to set meters
e. Volt-ohm-millimeter (VOM)
f. Components of a VOM
g. Ohms scale
h. Reading a VOM
i. Measuring voltage with a VOM
j. Non-linear

Provide Demonstration On:

Reading meters

Provide Practical Application On:

a. Reading various types of meters
b. Setting meters using given data

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-03a, EL-03b, EL-03c, "Using Electric Meters"

Student Manuals:

Georgia, Electricity, Unit EL-03

Tools and Equipment:

Various electric meters

CLASSROOM HOURS

18

EVALUATION (EL-03)

a. Given an electric meter and data, the student will set a meter and read electrical quantities correctly.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-04 Understanding series and parallel circuits

PERFORMANCE OBJECTIVE

Demonstrate a knowledge of series, parallel and series/parallel circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Requirements for an electric current
b. Electrical load
c. Method of controlling the load
d. Characteristics of a series circuit
e. Uses of a series circuit
f. Measurement of electrical characteristics in series circuits
g. Parallel circuits
h. Uses of a parallel circuits
i. Measurement of electrical characteristics in a parallel circuit
j. Series/parallel circuit
k. Uses of the S/P circuit
l. Measurement of electrical characteristics in the S/P circuit

Provide Demonstration On:

Calculations for the electrical quantities in series, parallel and combination circuits

Provide Practical Application On:

Laying out and wiring a series and parallel circuit using a wiring board and making readings on the different components

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-04a, EL-04b, "Demonstrate a Knowledge of Series and Parallel Circuits"

Student Manuals:

Georgia, Electricity, Unit EL-04

Tools and Equipment:

a. Wiring board
b. Electrical wire
c. Meters
d. Light sockets and lights
e. Power source

CLASSROOM HOURS 18

EVALUATION (EL-04)

a. Given a wiring board and other proper equipment and materials, the student should:
   1. Lay out, wire and take readings on a series and a parallel circuit.
   2. Draw a series/parallel circuit from specifications.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-05 Identifying electrical symbols

PERFORMANCE OBJECTIVE

Identify electrical symbols.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The function of symbols in wiring diagrams
b. Symbols for:
   1. Loads
      -Motors
      -Solenoids
      -Heaters
      -Signal lights
   2. Contactors and relays
   3. Magnetic starter
   4. Switches
      -Throw
      -Thermostats
      -Pressure switches
      -Push button switches
      -Connect switches
   5: Safety devices
      -Overloads
   6. Transformers

Provide Demonstration On:

a. Using various symbols in combination
b. Reading various kinds of wiring diagrams

Provide Practical Application On:

Identifying symbols

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-05a, EL-05b, EL-05c, EL-05d, "Identifying Symbols"

Student Manuals:

Georgia, Electricity, Unit EL-05

Tools and Equipment:

a. Electrical symbol chart
b. Assorted electrical components
c. Wiring diagrams

CLASSROOM HOURS

24

EVALUATION (EL-05)

a. Given a list of standard electrical symbols and an assortment of electrical components, the student will correctly match the electrical symbols with the correct electrical components.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-06 Reading a basic schematic diagram

PERFORMANCE OBJECTIVE

Read and interpret schematic diagrams.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Definition of a schematic diagram
- b. Elements in a schematic diagram
  - 1. Power source
  - 2. Current paths
  - 3. Load
- c. Reading simple schematic diagrams

Provide Demonstration On:

Reading a schematic diagram

Provide Practical Application On:

Drawing a schematic diagram given certain specifications

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-06, "Reading a Basic Schematic Diagram"

Student Manuals:

Georgia, *Electricity*, Unit EL-06

CLASSROOM HOURS 48

EVALUATION (EL-06)

a. Given a list of basic specifications, the student will draw a schematic diagram to represent the specifications.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-07 Reading advanced schematic diagrams

PERFORMANCE OBJECTIVE

Read and interpret advanced schematic diagrams.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. A review of symbols and reading basic schematic diagrams
b. The relationship of a schematic diagram with the actual electrical unit
c. Pictoral diagrams
d. Factual diagrams
e. Installation diagrams

Provide Demonstration On:

a. Reading an advanced schematic diagram
b. Reading other types of wiring diagrams

Provide Practical Application On:

Drawing an advanced schematic diagram given certain specifications

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

Student Manuals:

Georgia, Electricity, Unit EL-07

CLASSROOM HOURS

48

EVALUATION (EL-07)

a. Given a list of specifications and an actual electrical unit, the student will draw a schematic diagram to match the specifications.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-08 Applying alternating current principles

PERFORMANCE OBJECTIVE

Demonstrate an understanding of the principles of alternating current.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Definition of alternating current
b. Basic concepts of alternating current
    1. Sine wave
    2. Cycles and frequency
    3. Effective voltage
    4. Voltage - Current systems
    5. Phase
    6. Inductance and reactance
        -Inductive reactance
        -Capacitive reactance
        -Impedance

(Continued on back)

Provide Practical Application On:

a. Measuring the voltage of a:
    1. 230v-10-60hz voltage system
    2. Delta (230v-30hz)
    3. WYE (208-3-60_ voltage system
    4. 460v-30-60hz voltage system
b. Making connections in the panel to obtain:
    1. 230v-1-60 cycles
    2. 115-1-60 cycles
    3. 280-3-60 cycles
    4. 230-3-60 cycles
    5. 460v-30-60hz cycles

(Continued on back)

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

Student Manuals:

Georgia, Electricity, Unit EL-08

Tools and Equipment:

a. Volt meter
b. Wiring panels
c. Delta and WYE voltage systems

CLASSROOM HOURS

15

EVALUATION (EL-08)

a. Given proper equipment and materials, the student will:
   1. Measure the voltage of various voltage systems and identify the ground, hot legs and high legs of each system.
   2. Draw a power distribution system from specifications.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

   7. Power
      - True power
      - Apparent power
      - Power factor
      - Power distribution

c. Single phase alternating current systems
d. Three-phase voltage systems
e. Higher-voltage systems
f. Advantages and disadvantages of different systems
g. Measurement of current, voltage and amperage
h. Transformer hookups
   1. Delta
   2. Wye

Provide Practical Application On:

c. Identifying the ground, hot legs and high legs
   1. 230v-1Ø-60hz voltage system
   2. 230v-3Ø-60hz voltage system
   3. 460v-3Ø-60hz voltage system

d. Drawing a power distribution system, given various specifications, from an electrical source, to a substation, to a transformer, to a structure

TASK

EL-09 Determining and selecting wire size and making connections

PERFORMANCE OBJECTIVE

Determine wire size and type per ampacity.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Regulations of the National Electrical Code
b. Wiring characteristics
    1. Type of metal
    2. Insulation
    3. Size
c. Wire-sizing charts
d. Ampacity
e. Voltage drop
f. Disconnect switches
    1. Enclosures
    2. Fusible and nonfusible switches
g. Fusible load centers
h. Breaker panels
i. Distribution centers
j. Making connections

Provide Demonstration On:

Various wire sizes and types for different electrical units

Provide Practical Application On:

Sizing wire for various assigned electrical units

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-09a, EL-09b, "Determining, Selecting Wire Size and Making Connections"

Student Manuals:

Georgia, Electricity, Unit EL-09

Tools and Equipment:

a. Various types and sizes of wire
b. Wire-sizing charts

CLASSROOM HOURS 18

EVALUATION (EL-09)

a. Given two air conditioning units with specifications and other proper equipment, the student will determine and select the proper wire size for connecting the unit.

b. Georgia, Electro Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-10 Making main panel connections

PERFORMANCE OBJECTIVE

Make a main panel connection for an air conditioner.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Disconnect switch
b. Load side of the disconnect
c. Connection of power wires
d. Connection of ground wires
e. Single phase disconnect
f. Three phase disconnect
g. Fusible load center
h. Distribution center
i. Breaker panels
    1. Main breakers
    2. Installation
        -Type and size of wiring
    3. Pole breakers

(Continued on back)

Provide Demonstration On:

Panel connections for an air conditioner

Provide Practical Application On:

a. Making a main panel connection for an air conditioner
b. Making connections in a fusable load center
c. Installing various types of circuit breakers in a breaker panel

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-10a, EL-10b, "Making Main Panel Connections"

Student Manuals:

Georgia, *Electricity*, Unit EL-10

Tools and Equipment:

a. Air conditioning unit
b. Breaker panel
c. Wiring
d. Small hand tools

CLASSROOM HOURS

15

EVALUATION (EL-10)

a. Given an air conditioning unit, proper equipment and materials, the student will make the proper main panel connections for an air conditioning unit according to equipment specifications and local and State codes.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

j. Correcting faulty connections
k. Connections for air conditioners
l. Fuses

TASK

EL-11 Servicing shaded pole motors

PERFORMANCE OBJECTIVE

Install, wire and operate a shaded pole motor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electric motors
    1. Torque
    2. Magnetism
        -Magnetic field
        -Induced magnetism
        -Permanent magnet
        -Electromagnet
    3. Rotor
    4. Stator
    5. Motor strength
    6. Open and enclosed motors

b. Types of motors
    1. Shaded pole
    2. Split phase
    3. Permanent split capacitor

(Continued on back)

Provide Demonstration On:

a. The various types of motors
b. A shaded pole motor

Provide Practical Application On:

Diagnosing malfunctions in a shaded pole motor

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-11a, EL-11b, "Servicing Shaded Pole Motors"

Student Manuals:

Georgia, *Electricity*, Unit EL-11

Tools and Equipment:

a. Shaded pole motor
b. Hand tools

CLASSROOM HOURS 9

EVALUATION (EL-11)

a. Given a shaded pole motor and other proper equipment, the student will disassemble and reassemble the motor, identifying all parts. The reassembled motor will function properly.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

INSTRUCTION ACTIVITIES

Provide Information On:

    4. Capacitor-start-capacitor run
    5. Three-phase
c. Shaded-pole motor
    1. Operation
    2. Reversing
    3. Troubleshooting
        -Winding
        -Bearings

TASK

EL-12 Wiring split-phase motors

PERFORMANCE OBJECTIVE

Install and operate a 230 volt split-phase motor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electric motors
b. Components of a motor
c. Split-phase motors
    1. Winding layout
    2. Voltage
    3. Centrifugal switch
    4. Dual voltage split phase motor
d. Wiring a split-phase motor
e. Operation of a split-phase motor
f. Diagnosing malfunctions in a split-phase motor
g. Hermetic

Provide Demonstration On:

A split-phase motor in operation

Provide Practical Application On:

a. Wiring a split-phase motor
b. Diagnosing malfunctions in split-phase motors

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-11b, "Servicing Shaded Pole Motors"

Student Manuals:

Georgia, Electricity, Unit EL-12

Tools and Equipment:

a. Split-phase motor
b. Hand tools

CLASSROOM HOURS

21

EVALUATION (EL-12)

a. Given a split-phase motor and other proper equipment, the student will disassemble, reassemble and identify parts of the motor. The reassembled motor will function properly.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-13 Checking capacitors

PERFORMANCE OBJECTIVE

Diagnose the condition and identify replacement capacitors on electric motors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function of a capacitor
b. Starting capacitor
c. Running capacitor
d. Microfarad
e. Checking a capacitor with an ohmmeter
f. Other capacitor testors
g. Capacitor rules
h. Total capacitance of a capacitor
i. Diagnosing malfunctions

Provide Demonstration On:

a. A capacitor and its component parts
b. Calculating the capacitance of a capacitor

Provide Practical Application On:

Diagnosing malfunctions in different types of capacitors

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-13, "Checking Capacitors"

Student Manuals:

Georgia, Electricity, Unit EL-13

Tools and Equipment:

a. Capacitor
b. Ohmmeter
c. Volt meter
d. Hand tools
e. Various electric motors with capacitors

CLASSROOM HOURS

9

EVALUATION (EL-13)

a. Given electric motors with starting and running capacitors, and other proper equipment, the student will check the voltage and microfared rating and will replace faulty capacitors so that the motors function properly.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-14 Hooking up and troubleshooting PSC motors

PERFORMANCE OBJECTIVE

Wire, install and troubleshoot permanent split capacitor (PSC) motors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Functioning of a permanent split capacitor motor
b. Component parts of a PSC motor
c. Diagnosing malfunctions in a PSC motor
   -Capacitor
   -Motor windings
   -Bearings
d. Multi-speed PSC motors

Provide Demonstration On:

A PSC motor in operation

Provide Practical Application On:

Diagnosing and repairing malfunctions in a multispeed motor

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

Student Manuals:

Georgia, Electricity, Unit EL-14

Tools and Equipment:

a. A PSC motor
b. Hand tools
c. Test instruments

CLASSROOM HOURS

24

EVALUATION (EL-14)

a. Given a PSC motor and other proper equipment, the student will disassemble and reassemble the motor, identify the component parts, and repair any malfunctions so that the motor functions properly.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-15 Hooking up and troubleshooting CS motors

PERFORMANCE OBJECTIVE

Wire, troubleshoot and install an open type capacitor start motor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function and characteristics of a CS motor
b. Open type CS motor
c. Enclosed type CS motor
d. Diagnosing malfunctions
e. Component parts of a CS motor
f. Relay type

Provide Demonstration On:

An operating CS motor

Provide Practical Application On:

Diagnosing malfunctions in a CS motor

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-15, "Hooking Up and Troubleshooting CS motors"

Student Manuals:

Georgia, *Electricity*, Unit EL-15

Tools and Equipment:

a. A CS motor
b. Hand tools
c. Test instruments

CLASSROOM HOURS

36

EVALUATION (EL-15)

a. Given an open type CS motor, the student will disassemble and reassemble the motor, identify the parts and make any necessary repairs so that the motor functions properly.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-16 Hooking up and troubleshooting CSR motors

PERFORMANCE OBJECTIVE

Troubleshoot and connect a CSR motor and starting relay.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function of a capacitor start-capacitor run CSR motor
b. Component parts of a CSR motor
c. Operation of a CSR motor
d. Connecting a CSR motor
e. Diagnosing malfunctions
    1. Windings
    2. Bearings
    3. Potential relays
    4. Starting capacitor
    5. Running capacitor
    6. Relay
    7. Compressor

Provide Demonstration On:

A functioning CSR motor

Provide Practical Application On:

a. Diagnosing various malfunctions in a CSR motor
b. Wiring and operating a CSR motor

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-16, "Hooking Up and Troubleshooting a CSR Motor"

Student Manuals:

Georgia, Electricity, Unit EL-16

Tools and Equipment:

a. CSR motor
b. Hand tools
c. Test instruments

CLASSROOM HOURS 9

EVALUATION (EL-16)

a. Given a CSR motor and proper equipment, the student will:
   1. Wire the CSR motor with a potential relay
   2. Diagnose and repair various malfunctions in the CSR motor

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-17 Connecting three phase motors

PERFORMANCE OBJECTIVE

Connect a three phase motor so that it functions properly, diagnose and repair any problems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function of a three phase motor
b. Component parts of a three phase motor
c. Operation of a three phase motor
d. Diagnosing malfunctions
    1. Reading the resistance of the winding
    2. Problems with a three phase motor
e. Connecting a three phase motor

Provide Demonstration On:

An operating three phase motor

Provide Practical Application On:

Diagnosing malfunctions in a three phase motor using an ohmmeter

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

Student Manuals:

Georgia, Electricity, Unit EL-17

Tools and Equipment:

a. Three phase motor
b. Hand tools
c. Test instruments

CLASSROOM HOURS 9

EVALUATION (EL-17)

a. Given a three phase motor and other proper equipment, the student will use an ohmmeter to diagnose various malfunctions in the motor and make proper repairs so that the motor functions properly.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-18 Testing motors

PERFORMANCE OBJECTIVE

Determine motor failure causes in shaded pole, split phase, PSC, CS, CSR, and three phase motors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Characteristics of each motor type
b. Use of each type of motor
c. Testing methods for each type of motor
d. Repairing each type of motor

Provide Demonstration On:

a. Each motor in operation
b. Testing each motor

Provide Practical Application On:

Diagnose various malfunctions in each type of motor.

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

Student Manuals:

Georgia, Electricity, Unit EL-18

Tools and Equipment:

a. Motors (shaded pole, split phase, PSC, CS, CSR, three phase)
b. Hand tools
c. Ohmmeter
d. Voltage meters

CLASSROOM HOURS 14

EVALUATION (EL-18)

a. Given one of each motor type and other proper equipment, the student will diagnose malfunctions in each type of motor.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-19 Maintaining electric motors

PERFORMANCE OBJECTIVE

Perform maintenance on electric motors, including changing and lubricating bearings, aligning belts and installing drive couplings.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Motor types and their characteristics
b. Component parts of motors
    1. Relays
    2. Motor bearings
    3. Motor drives
        -Belts
        -Couplings
    4. Starters
    5. Switches
c. Maintenance activities
d. Testing motors

Provide Demonstration On:

Maintaining various parts of an electric motor

Provide Practical Application On:

a. Inspecting direct drive motors and listing coupling types
b. Adjust the V-belt on various motors
c. Changing and lubricating bearings

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

Student Manuals:

Georgia, Electricity, Unit EL-19

Tools and Equipment:

a. Various motor types
b. V-belts
c. Bearings
d. Hand tools

CLASSROOM HOURS 9

EVALUATION (EL-19)

a. Given a variety of motor types and other proper equipment, the student will:
   1. Make belt adjustments
   2. Lubricate and replace bearings
   3. Install couplings where necessary

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-20 Installing and testing transformers

PERFORMANCE OBJECTIVE

Diagnose problems and replace a transformer on a small residential air conditioner.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function of transformers
b. Component parts of a transformer
c. Types of transformers
d. Sizing transformers
e. Diagnosing malfunction
    1. Ohmmeter
    2. Volt meter
f. Replacing transformers

Provide Demonstration On:

a. Using the volt meter and the ohmmeter to diagnose malfunctions in a transformer
b. Recording data from tests

Provide Practical Application On:

a. Replacing faulty transformers
b. Diagnosing malfunctions in transformers

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-20, "Installing and Testing a Transformer"

Student Manuals:

Georgia, Electricity, Unit EL-20

Tools and Equipment:

a. Transformer
b. Volt meter
c. Ohmmeter
d. Hand tools
e. Small air conditioner

CLASSROOM HOURS

12

EVALUATION (EL-20)

a. Given an air conditioning unit which may or may not have a faulty transformer, the student will perform a voltage and ohm test and determine the condition of the transformer. The student will properly record the readings from the tests. The student will replace faulty transformers.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-21 Installing and testing contactors and relays

PERFORMANCE OBJECTIVE

Install and test contactors and relays.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function of a contactor
b. Parts of a contactor
   1. Coil
   2. Contacts
   3. Armature
   4. Laminated core
   5. Poles
   6. Mechanical linkage
c. Diagnosing faulty contractors
   1. Coil
   2. Contacts
   3. Mechanical linkage
d. Function of relays
e. Parts of a relay
   1. Contacts

(Continued on back)

Provide Demonstration On:

a. Installing a contactor
b. Testing the parts of a contactor
c. Installing a relay
d. Testing the parts of a relay

Provide Practical Application On:

a. Drawing wiring diagrams of a contactor and a relay controlling motor
b. Diagnosing various malfunctions in a relay and in a contactor
c. Installing a contactor and a relay

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-21a, EL-21b, "Installing and Testing Contactors and Relays"

Student Manuals:

Georgia Electrici[illegible]
Unit EL-21

Tools and Equipment:

a. Relays and contactors with various malfunctions
b. Volt meter
c. Ohmmeter
d. Hand tools

CLASSROOM HOURS 12

EVALUATION (EL-21)

a. Given various faulty relays and contactors, volt meter, ohmmeter and other proper equipment, the student will determine the part(s) that are malfunctioning.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

    2. Armature
    3. Coil
    4. Mechanical linkage
    5. Enclosure
f. Diagnosing faulty relays
g. Installing contactors
   and relays

TASK

EL-22 Installing and checking thermostats

PERFORMANCE OBJECTIVE

Install and check various types of thermostats.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function of a thermostat
b. Applications of thermostats
c. Component parts of a thermostat
d. Remote bulb thermostat
e. Bimetal thermostat
f. Line voltage thermostat
g. Low-voltage thermostat
h. Anticipators
i. Staging thermostats
j. Installing thermostats
k. Servicing thermostats

Provide Demonstration On:

a. Schematic diagrams of various thermostats
b. Installing a thermostat
c. Testing a thermostat

Provide Practical Application On:

a. Setting heat anticipators on a gas heating system
b. Setting a cooling anticipation on an air conditioning system
c. Installing various types of thermostats
d. Testing for faulty thermostats
e. Reading schematic diagrams of thermostats

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/V:

Georgia, slide/tape EL-22a, EL-22b, "Installing and Checking Thermostats"

Student Manuals:

Georgia, Electricity, Unit EL-22

Tools and Equipment:

a. Various types of thermostats
b. Hand tools
c. Gas heating system
d. Air conditioning system
e. Refrigeration system

CLASSROOM HOURS 30

EVALUATION (EL-22)

a. Given various faulty thermostats and other proper equipment, the student will determine the specific problem with each thermostat. The student will repair, where possible, each thermostat so that it functions properly.

b. Given a heating, air conditioning refrigeration system and proper tools, the student will install the proper type of thermostat so that the system operates properly.

c. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-23 Installing and checking pressure switches

PERFORMANCE OBJECTIVE

Install, set and troubleshoot high pressure and low pressure switches.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function of a pressure switch
b. High pressure switches
c. Low pressure switches
d. Differential
e. Cut-in
f. Cut-out
g. Range
h. Diagnosing malfunctions
i. Common malfunctions
j. Pressure switches used as an operating control
k. Testing pressure switches

Provide Demonstration On:

a. Installing high and low pressure switches
b. Setting pressure switches
c. Testing pressure switches

Provide Practical Application On:

a. Setting pressure switches on various cooling units
b. Installing pressure switches
c. Diagnosing malfunctions in various pressure switches

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-23a, EL-23b, EL-23c, "Installing and Checking Pressure Switches"

Student Manuals:

Georgia, Electricity, Unit EL-23

Tools and Equipment:

a. Various cooling units
b. High pressure and low pressure switches
c. Hand tools
d. Gauges

CLASSROOM HOURS 18

EVALUATION (EL-23)

a. Given the proper equipment and materials, the student will:
   1. Diagnose malfunctions in several high and low pressure switches
   2. Install proper pressure switches in various units
   3. Set correctly the newly installed pressure switches

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-24 Troubleshooting overload devices

PERFORMANCE OBJECTIVE

Locate faulty overload devices and repair or replace the malfunctioning devices.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function of an overload
b. Fuses
c. Circuit Breakers
d. Time voltage overload
e. Pilot duty overload
f. Thermal overloads
g. Magnetic overload
h. Internal overload
i. Testing overloads
j. Diagnosing malfunctions
k. Installing overloads

Provide Demonstration On:

Various types of overloads

Provide Practical Application On:

a. Diagnosing malfunctions in various types of overloads
b. Installing overloads

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

Student Manuals:

Georgia, Electricity,
Unit EL-24

Tools and Equipment:

a. Overloads
    1. Line voltage
    2. Pilot duty
    3. Magnetic
    4. Thermal
b. Hand tools
c. Ohmmeter
d. Compressor

CLASSROOM HOURS 18

EVALUATION (EL-24)

a. Given several types of faulty overloads and other proper equipment, the student will diagnose the malfunctions.

b. Given a thermal overload, a compressor and other proper tools and equipment, the student will install the overload on the compressor.

c. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-25 Installing and checking various electric control devices

PERFORMANCE OBJECTIVE

Install and check electro-mechanical controls.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Sequencers
b. Time delay relays
c. Humidistats
d. Oil safety switches
e. Time clock
f. Solenoid valves
g. Diagnosing malfunctions
h. Installation

Provide Demonstration On:

Functioning electric control devices

Provide Practical Application On:

Installing various electric control devices

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape, EL-25, "Installing and Checking Miscellaneous Controls"

Student Manuals:

Georgia, Electricity, Unit EL-25

Tools and Equipment:

a. Sequencers
b. Time delay relays
c. Humidistats
d. Oil safety switches
e. Time clock
f. Solenoid valves
g. Hand tools
h. Ohmmeter
i. Volt meter
j. Electric furnace
k. Gas furnace
l. Compressor
m. Air conditioning system
n. Humidifier

CLASSROOM HOURS

12

EVALUATION (EL-25)

a. Given various electric control devices and other proper equipment and tools, the student will install and check each device so that the equipment operates properly:
   1. Install a sequencer on an electric furnace
   2. Install a time delay relay on a gas furnace to delay the fan motor starting
   3. Install a humidistat on a humidifier
   4. Install and check out an oil safety switch on a compressor
   5. Install a seven-say time clock on an air conditioning system using a given set of times

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-26 Troubleshooting magnetic starters

PERFORMANCE OBJECTIVE

Diagnose malfunctions in magnetic starters and repair or replace the faulty starters.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function of a magnetic starter
b. Parts of a magnetic starter
   1. Contacts
   2. Magnetic coil
   3. Overloads
   4. Mechanical linkage
c. Sizing magnetic starters
d. Bimetal relay
e. Thermal relay
f. Molten alloy relay
g. Diagnosing malfunctions
h. Installation
i. Push-button stations
   1. Installation
   2. Diagnosing malfunctions
   3. Function

Provide Demonstration On:

a. A magnetic starter in operation
b. A push button starter in operation

Provide Practical Application On:

a. Disassembling and reassembling a magnetic starter
b. Drawing a wiring diagram of a magnetic starter
c. Sizing and installing a magnetic starter to a motor
d. Diagnosing malfunctions in a magnetic starter and a push button station

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-26a, EL-26b, "Troubleshooting Magnetic Starters"

Student Manuals:

Georgia, Electricity, Unit EL-26

Tools and Equipment:

a. Magnetic starter
b. Push button starter
c. Hand tools
d. Test instruments

CLASSROOM HOURS

30

EVALUATION (EL-26)

a. Given two faulty magnetic starters, one with a thermostat and one with push button control and other proper equipment, the student will diagnose the source of the malfunction.

b. Given a magnetic starter, a motor, and other tools and equipment, the student will properly size and install a magnetic starter.

c. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-27 Wiring packaged air conditioners

PERFORMANCE OBJECTIVE

Determine wire size and wire a packaged air conditioner.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Parts of a packaged unit
b. Air-cooled packaged unit
c. Water-cooled packaged unit
d. Wiring packaged units
e. Sizing the wire
f. Installation

Provide Demonstration On:

a. A schematic diagram of a packaged unit
b. Wiring a packaged unit

Provide Practical Application On:

Sizing the wire and wiring a packaged air conditioner

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-27 "Wiring Packaged Air Conditioners"

Student Manuals:

Georgia, Electricity, Unit EL-27

Tools and Equipment:

a. A packaged air conditioner unit
b. Wiring
c. Sizing chart
d. Hand tools

CLASSROOM HOURS 6

EVALUATION (EL-27)

a. Given a packaged air conditioning unit with a data sheet and other proper equipment, the student will select the proper size wire and correctly wire the unit.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-28 Wiring split system air conditioning units

PERFORMANCE OBJECTIVE

Determine wire size and wire a split system air conditioning unit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Split air conditioning system
    1. Evaporator
    2. Condensor
b. Piping and wiring
c. Installation
d. Wiring and sizing wire

Provide Demonstration On:

Sizing wiring for a split system air conditioning unit

Provide Practical Application On:

Determining wire size and wiring a split system air conditioning unit

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-28, "Wiring Split System Air Conditioning"

Student Manuals:

Georgia, Electricity, Unit EL-28

Tools and Equipment:

a. Split system air conditioning unit
b. Wiring
c. Sizing chart
d. Hand tools

CLASSROOM HOURS 9

EVALUATION (EL-28)

a. Given a split system air conditioning unit and other proper equipment and materials, the student will wire the system using the proper size wire so that the system operates properly.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Test, 1980.

TASK

EL-29 Designing a control panel

PERFORMANCE OBJECTIVE

Design and assemble an operating control panel for a packaged air conditioning unit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Wiring diagrams
b. Component parts of a control system
    1. Compressor
    2. Capacitor
    3. Switches
    4. Wiring
    5. Condensor
c. Function of a control system

Provide Demonstration On:

An operation control system for an air cooled packaged unit

Provide Practical Application On:

Designing a control panel for an air cooled packaged unit

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

Student Manuals:

Georgia, *Electricity*,
Unit EL-29

Tools and Equipment:

a. Wiring
b. Plywood
c. Lights
d. Switches
e. Thermostat
f. Hand tools
g. Power supply

CLASSROOM HOURS 18

EVALUATION (EL-29)

a. Given the proper materials the student will design and assemble an operating control system for a packaged air conditioning unit.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-30 Designing an advanced control panel

PERFORMANCE OBJECTIVE

Design and construct an advanced control panel.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Reading wiring diagrams
b. Function of a control panel
c. Component parts of a control panel
d. Designing control panels

Provide Demonstration On:

A schematic diagram of an advanced control panel

Provide Practical Application On:

a. Reading wiring diagrams
b. Designing an advanced control panel

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

Student Manuals:

Georgia, Electricity, Unit EL-30

Tools and Equipment:

a. Plywood
b. Power supply
c. Light bulbs
d. Switches
e. Wiring

CLASSROOM HOURS

18

EVALUATION (EL-30)

a. Given proper materials, the student will draw a schematic diagram of a roof top two-stage cooling and two-stage heating unit.

b. Given the proper materials, the student will design and construct a control panel for a heat pump using a two-stage heating and one-stage cooling thermostat to control the unit.

c. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-31 Troubleshooting a basic electrical control system

PERFORMANCE OBJECTIVE

Diagnose malfunctions in a basic electrical control system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electrical control devices
    1. Contactors and relays
        - Contacts
        - Coils
    2. Overloads
        - Fuse
        - Circuit breakers
        - Line voltage overloads
        - Pilot duty overloads
        - Internal overloads
    3. Thermostats
        - Line voltage thermostat
        - Low-voltage thermostat

(Continued on back)

Provide Demonstration On:

Method for diagnosing malfunctions

Provide Practical Application On:

Diagnosing malfunctions in various electrical systems

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-31, "Troubleshooting Electrical Control Systems"

Student Manuals:

Georgia, *Electricity*, Unit EL-31

Tools and Equipment:

a. Provide various electrical systems with malfunctions
b. Hand tools
c. Testing devices

CLASSROOM HOURS 18

EVALUATION (EL-31)

a. Given a malfunctioning electrical control system and proper equipment, the student will diagnose and repair the problem.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

    4. Pressure switches
    5. Transformers
    6. Electric motors
b. Method for diagnosing malfunctions
    1. Check power supply
    2. Control voltage
    3. Determine operating loads
    4. Find loads on wiring diagram that are not operating and check circuits
    5. Hopscotch circuit to find faulty component
    6. Examine internal overloads

TASK

EL-32 Advanced troubleshooting of electrical control systems

PERFORMANCE OBJECTIVE

Diagnose and repair malfunctions in electrical control systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Reading wiring diagrams
b. Diagnosing electrical components
    1. Motors
    2. Switches
c. Diagnosing control systems
    1. Residential systems
    2. Total circuit
    3. Hopscotching
    4. Industrial systems
d. Troubleshooting charts
e. Systematic location of problem
    1. Power supply
    2. Control voltage
    3. Loads
    4. Internal overloads

Provide Demonstration On:

Diagnosing a problem in an advanced electrical control system

Provide Practical Application On:

a. Reading wiring diagrams
b. Diagnosing malfunctions in various electrical control systems

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

Student Manuals:

Georgia, Electricity, Unit EL-32

Tools and Equipment:

a. Various electrical system with malfunctions
b. Hand tools
c. Testing devices

CLASSROOM HOURS

18

EVALUATION (EL-32)

a. Given 5 advanced control systems with various malfunctions and proper materials, the student will diagnose and repair the problems.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

TASK

EL-33 Servicing solid-state control circuits

PERFORMANCE OBJECTIVE

Diagnose malfunctions and repair solid state control circuits.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Mini-computer
b. Logic board
c. Princed circuit (PC) board
d. Integrated circuit (IC)
e. Chip
f. Chipboard
g. Module
h. Characteristics of solid state circuits
i. Symptoms of solid state control circuit failure

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Provide Demonstration On:

a. Solid state circuits
b. Using testing devices

Provide Practical Application On:

Using various testing devices to identify faulty components in a solid state system

INSTRUCTIONAL MATERIALS

Textbooks:

Smith

A/Vs:

Georgia, slide/tape EL-33, "Servicing Solid State Control Circuits"

Student Manuals:

Georgia, Electricity, Unit EL-33

Tools and Equipment:

a. Solid state control circuits
b. High resistance tester
c. Whole system tester
d. Continuity tester

CLASSROOM HOURS 18

EVALUATION (EL-33)

a. Given various testers and faulty solid state systems, the student will diagnose the problems and make proper repairs.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, Criterion Referenced Tests, 1980.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

j. Testing solid state control circuits
    1. Manufacturers alignment and fault detector tester (whole system tester)
    2. High resistance volt meter
    3. Continuity tester

k. Special problems in testing solid state circuits

l. Replacing solid state circuits

TASK

RF-01 Becoming familiar with career opportunities in refrigeration

PERFORMANCE OBJECTIVE

Identify the career opportunities available in refrigeration and related fields.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Various types of refrigeration units
b. Job potential as related to the refrigeration and air conditioning field
c. Section III of this Curriculum Guide

Provide Demonstration On:

Different types of refrigeration systems and their best use by the consumer

Provide Practical Application On:

Observing various types of refrigeration systems in lab area

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Doolin

Student Manuals:

a. Georgia, Refrigeration, Unit REF-01
b. Copeland

CLASSROOM HOURS 3

EVALUATION (RF-01)

a. The student will identify several types of refrigeration systems and their best application.

b. The student will demonstrate knowledge of career opportunities available in refrigeration and related fields.

c. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

RF-02 Identifying safe working conditions

PERFORMANCE OBJECTIVE

Identify and practice safe working habits in the laboratory and in the work place.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Shop safety rules
b. Protective clothing
c. Fire hazards
d. Electrical hazards
e. Freon hazards
f. Types of safety equipment
    1. Fire extinguishers
    2. Clothing
    3. First aid supplies
g. First aid

Provide Demonstration On:

a. Use of safety equipment
b. Proper handling of equipment
c. First aid

Provide Practical Application On:

a. Handling fire extinguishers
b. First aid practices

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Carrier Corp., A Safety Guide for Refrigeration and Air Conditioning

A/Vs:

Georgia, slide/tape REF-02, "Identifying Safe Working Conditions"

Student Manuals:

Georgia, Refrigeration, Unit REF-02

Tools and Equipment:

a. Fire extinguishers
b. First aid supplies

CLASSROOM HOURS

6

EVALUATION (RF-02)

Given a list of standard shop materials, equipment and practices, the student will correctly identify safe and unsafe practices and precautionary measures to be taken to prevent hazardous situations.

TASK

RF-03 Demonstrating a knowledge of the basic refrigeration concepts

PERFORMANCE OBJECTIVE

Demonstrate an understanding of the basic concepts of refrigeration.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Heat, energy and cold
b. Refrigeration effect
c. Three types of heat
d. Heat measurement
e. F. and C. conversions
f. B.T.U.
g. Three ways of heat transfer
h. Ambiant termperature
i. Gauge pressures
j. Boiling point
k. Thermostat
l. Compressor
m. Melting point
n. Liquefaction
o. Vaporization
p. Condensation

Provide Demonstration On:

a. Methods of heat transfer
b. Centigrade and fahrenheit conversions
c. Measuring temperatures

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.

A/Vs:

Georgia, slide/tape REF-03, "Understanding Basic Refrigeration Concepts"

Student Manuals:

a. Georgia, Refrigeration, Unit REF-03
b. Copeland

CLASSROOM HOURS 20

EVALUATION (RF-03)

a. Given a list of the basic terms and principles used in refrigeration, the student will correctly match the terms and principles with their definitions.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

RF-04 Demonstrating knowledge of the basic refrigeration cycle

PERFORMANCE OBJECTIVE

Demonstrate an understanding of the basic refrigeration cycle.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Compressor, condenser, metering device and evaporator
b. Various pressures and temperatures during the refrigeration cycle
c. Transfer and types of heat
d. Theory of condensation
e. Sub-cooling
f. Freons
g. Conditions of refrigerant during the refrigeration cycle

Provide Demonstration On:

a. Major and minor components of the refrigeration cycle
b. Conditions of the refrigerant during the refrigeration cycle

Provide Practical Application On:

Identifying components and their functions on a refrigeration trainer

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

A/Vs:

Georgia, slide/tape REF-04a, REF-04b, REF-04c, "Understanding the Basic Refrigeration Cycle"

Student Manuals:

a. Georgia, Refrigeration, Unit REF-04
b. Copeland

Tools and Equipment:

Refrigeration trainer

CLASSROOM HOURS

24

EVALUATION (RF-04)

a. Given a refrigeration trainer, diagrams of the refrigeration system, or an actual refrigeration unit, the student will identify the purpose and function of each component in the system, explain the heat transfer process and describe the condition of the refrigerant during each stage of the refrigeration cycle.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

RF-05 Using refrigeration tools

PERFORMANCE OBJECTIVE

Demonstrate the proper handling and use of tools used in refrigeration.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Electric drill
b. Bench grinder
c. Hand tools
d. Detecting faults and safety features on various hand tools
e. Thermometers
f. Pressure gauges
g. Tubing cutter

Provide Demonstration On:

The use of various tools used in refrigeration

Provide Practical Application On:

The use of various tools on the refrigeration trainer

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

A/Vs:

Georgia, slide/tape REF-05, "Identifying Tools"

Student Manuals:

Georgia, Refrigeration, Unit REF-05

Tools and Equipment:

a. Hand tools
b. Electric grinder
c. Electric drill
d. Refrigeration trainer

CLASSROOM HOURS 12

EVALUATION (RF-05)

a. Given a set of various tools used in refrigeration and a refrigeration trainer, the student will demonstrate the correct application for a tool and a given job.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

RF-06 Tapping, threading and replacing threads

PERFORMANCE OBJECTIVE

Drill correct size hole and tap internal threads and prepare external threads for pipe and standard bolt sizes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Tapping and threading
b. Types of bolts and pipe
c. Washers and nuts
d. Standard and metric threads
e. Types of screwdrivers
f. Threads per inch on galvanized and black pipe
g. Self-tapping screws
h. Sizing bits for tapping threads
i. Pipe fitting

Provide Demonstration On:

Tapping and threading

Provide Practical Application On:

a. Tapping and threading
b. Tapping and threading galvanized black pipe

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

A/Vs:

Georgia, slide/tape REF-06, "Tapping, Threading and Replacing Threads"

Student Manuals:

Georgia, Refrigeration, Unit REF-06

Tools and Equipment:

a. Hand tools
b. Tapping and die sets
c. Vice
d. Assorted screws and bolts
e. Assorted fittings
f. Galvanized and black pipe
g. Metal stock

CLASSROOM HOURS 6

EVALUATION (RF-06)

a. Given proper tools, equipment and various specifications, the student will thread two pieces of pipe and connect them with a coupling. The student will drill and tap a piece of metal stock.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

RF-07 Becoming familiar with fitting nomenclature and pipe materials

PERFORMANCE OBJECTIVE

Identify the different types of pipe and tube fittings used in refrigeration systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Flare fittings
b. Sweat fittings
c. Quick couplings
d. Compression fittings
e. Types of tubing
f. Types of pipe

Provide Demonstration On:

Various types of fittings and pipe materials

Provide Practical Application On:

Identifying various types of fittings and pipe materials

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

Student Manuals:

Georgia, Refrigeration, Unit REF-07

Tools and Equipment:

a. Flare fittings
b. Sweat fittings
c. Compression fittings
d. Tubing (copper)
e. Pipe (pvc)

CLASSROOM HOURS

9

EVALUATION (RF-07)

a. Given a list of terms and materials used in fitting operations, the student will correctly match each term and material with its use in fitting operations.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

RF-08 Performing basic copper tubing operations

PERFORMANCE OBJECTIVE

Cut and bend soft and hard copper tubing.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Selecting proper tools for flaring, swaging, cutting and bending copper tubing
b. Proper method of preparing copper tubing for joining together
c. To select proper tools for flaring copper tubing

Provide Demonstration On:

a. Cutting, swaging and bending copper tubing
b. Flaring copper tubing
c. Fitting together copper tubing

Provide Practical Application On:

a. Cutting tubing
b. Flaring copper tubing
c. Bending copper tubing
d. Swaging copper tubing

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice Hall, *Refrigeration and Air Conditioning*
b. Althouse, et al.
c. Delmar, *Principles of Refrigeration*

A/Vs:

Georgia, slide/tapes REF-08a, REF-08b, "Basic Copper Tubing Operations"

Student Manuals:

Georgia, *Refrigeration*, Unit REF-08

Tools and Equipment:

a. Swaging tools
b. Flaring tools
c. Bending tools
d. Tubing cutters
e. Copper tubing

CLASSROOM HOURS 12

EVALUATION (RF-08)

a. Given soft copper tubing and other proper materials and equipment, the student will make flared fittings and swaged joints and will bend with proper accuracy a 90° angle.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

RF-09 Soft soldering copper tubing

PERFORMANCE OBJECTIVE

Swage, clean, flux and soft solder copper tubing.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Safety
b. Joining copper tubing
c. Lighting the torch
d. Applying flux
e. Applying solder
f. Cleaning joints before soldering
g. Different types of solder
h. Capillary attraction
i. Procedures for brazing and soldering
j. Advantages of tin silver soldering

Provide Demonstration On:

a. Proper, flame while soldering
b. Applying solder correctly
c. Soldering air tight joints
d. Soldering uniform joints

Provide Practical Application On:

Soldering copper tubing with various types of solder until joints are uniform and air tight

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

A/Vs:

Georgia, slide/tape REF-09 "Soft Soldering Copper Tubing"

Student Manuals:

Georgia, Refrigeration, Unit REF-09

Tools and Equipment:

a. Tools
b. Torch
c. Gloves
d. Pliers
e. 50-50, 95-5 and silver solder
f. Soldering paste and flux
g. Copper tubing

CLASSROOM HOURS	18

EVALUATION (RF-09)

a. Given copper tubing and other proper materials and equipment, the student will prepare and solder two joints together. The joints must be air tight and uniform in appearance.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

RF-10 Silver brazing

PERFORMANCE OBJECTIVE

Silver braze refrigeration piping.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Definition of silver brazing
b. Oxyacetylene equipment
c. Type of flame
d. Torch angles for various jobs
e. Flow point of silver solder
f. Type and use of flux
g. Oil and oxygen mixture
h. Comparison chart and specification table for major competitive alloys
i. Brazing while tubing is under pressure

(Continued on back)

Provide Demonstration On:

a. Soldering technique with silver solder
b. Applying solder and flux
c. Flame control
d. Proper joints being uniform and free of leaks

Provide Practical Application On:

a. Cutting, shaping and joining copper tubing
b. Silver brazing copper tubing

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

A/Vs:

Georgia, slide/tape REF-10, "Silver Brazing"

Student Manuals:

Georgia, Refrigeration, Unit REF-10

Tools and Equipment:

a. Oxy-acetylene torch
b. Silver solder
c. Flux
d. Lighter
e. Copper tubing
f. Tools

CLASSROOM HOURS

18

EVALUATION (RF-10)

a. Given oxyacetylene equipment and proper materials, the student will prepare and silver braze leak proof joints with copper tubing.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

j. Ventilation
k. Safety
l. Preparing tubing to be brazed

TASK

RF-11 Handling refrigerants

PERFORMANCE OBJECTIVE

Demonstrate proper technique in handling, transforming, weighing and measuring refrigerants.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Refrigerant groups
b. Characteristics of each group
c. Safety precautions
d. Measuring refrigerants
e. Weighing refrigerants
f. Transferring refrigerants from one container to another

Provide Demonstration On:

The proper handling, transferring, weighing and measuring of each refrigerant group

Provide Practical Application On:

a. Checking the pressure on freon drums and recording the data
b. Determining type of freon from drum pressures
c. Transferring refrigerant from full to empty drums

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

A/Vs:

Georgia, slide/tape REF-11, "Handling Refrigerants"

Student Manuals:

a. Georgia, Refrigeration, Unit REF-11
b. Copeland

Tools and Equipment:

a. Gauge set
b. Thermometer
c. Temperature and pressure chart
d. Empty and full cylinder

CLASSROOM HOURS 10

EVALUATION (RF-11)

a. Given various refrigerants, containers and other equipment and materials, the student will safely transfer refrigerant from one container to another, check the pressure on tanks of gas and fill out data sheets properly.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

RF-12 Installing and using access valves

PERFORMANCE OBJECTIVE

Install and use various types of access (service) valves.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of access and service valves
b. Stem valves
c. Two way line valves
d. Tap on service valve
e. Schrader valves
f. Straddle valve
g. Piercing valves
h. Core type access valves
i. Line tap valves
j. Service valves or access valves
k. Applications for each type
l. Installing access valves
m. Cracking a valve
n. Process tube
o. Soldering the access service valve
p. Sight glass

Provide Demonstration On:

a. The function of the "stem type" service valve while installing and removing gauge lines
b. Method of installing the access valve

Provide Practical Application On:

a. Gaining entrance to the refrigeration system through a "stem type" service valve
b. Installing a soldered on Schrader type service valve

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

A/Vs:

Georgia, slide/tape REF-12, "Using Access Valves"

Student Manuals:

a. Georgia, Refrigeration, Unit REF-12
b. Copeland

Tools and Equipment:

a. Refrigeration systems
b. Access valves
c. Torch, solder and flux
d. Safety glasses
e. Gauge set
f. Leak detector

CLASSROOM HOURS 8

EVALUATION (RF-12)

a. Given proper equipment and materials, the student will gain entrance to the refrigeration system through a stem type service valve and will install on Schrader type service valve.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

RF-13 Maintaining refrigeration manifold gauges

PERFORMANCE OBJECTIVE

Calibrate a set of gauges at O-PSIG and check against gas in a given tank by corresponding temperature to pressure.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. High pressure gauge
b. Compound gauge
c. Function of the gauge and manifold set
d. Zero PSIG setting
e. Reading the pressure/temperature chart

Provide Demonstration On:

a. Reading gauges
b. Setting gauges at zero PSIG
c. Installing gauges

Provide Practical Application On:

a. Reading a series of gauges and recording data
b. Service valve inspection

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

A/Vs:

Georgia, slide/tape REF-13 "Maintaining Refrigeration Manifold Gauges"

Student Manuals:

a. Georgia, Refrigeration, Unit REF-13
b. Copeland

Tools and Equipment:

a. Manifold and gauges
b. Freon
c. Safety glasses
d. Pressure and temperature chart

CLASSROOM HOURS

4

EVALUATION (RF-13)

a. Given proper equipment and materials, the student will correctly calibrate and read a high pressure and a compound gauge.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

RF-14 Installing and using refrigeration manifold gauges

PERFORMANCE OBJECTIVE

Install and use refrigeration manifold gauges.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Use of manifold and gauge set
b. Installing manifold gauge
c. Purging
d. Positioning of service valve stems
e. Checking pressure drops
f. Safety hazards

Provide Demonstration On:

a. Installing and removing gauges and hoses
b. Reading gauges

Provide Practical Application On:

Installing and removing gauges on a refrigeration system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

A/Vs:

Georgia, slide/tape REF-14, "Installing and Using Refrigeration Manifold Gauges"

Student Manuals:

a. Georgia, Refrigeration, Unit REF-14
b. Copeland

Tools and Equipment:

a. Gauge and manifold set
b. Refrigeration system
c. Freon
d. Safety glasses
e. Assorted tools

CLASSROOM HOURS

11

EVALUATION (RF-14)

a. Given the proper tools and equipment, the student will properly install gauges on an operating system and measure system pressures.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

RF-15 Evacuating a refrigeration system

PERFORMANCE OBJECTIVE

Use a vacuum pump to evacuate a refrigeration system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Absolute pressure
b. Noncondensables
c. Low vacuum
d. High vacuum
e. Micron
f. Evacuation
g. Vacuum
h. Single state pump
i. Two state pump
j. Mercury monometer
k. Vacuum pump oil
l. Reasons for evacuating a refrigeration system
m. Effects of moisture on a refrigeration system
n. Effects of air in a refrigeration system

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Provide Demonstration On:

Procedures for evacuating a refrigeration system

Provide Practical Application On:

Evacuating a refrigeration system until all moisture and air are eliminated from the system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

A/Vs:

Georgia, slide/tape REF-15, "Using a Vacuum Pump"

Student Manuals:

a. Georgia, Refrigeration, Unit REF-15
b. Carrier, GTR Manuals
c. Copeland

Tools and Equipment:

a. Refrigeration system
b. Two stage vacuum pump
c. Manifold and gauge set
d. Freon
e. Assorted tools

CLASSROOM HOURS

12

EVALUATION (RF-15)

a. Given a refrigeration unit and proper equipment, the student will properly perform a multiple evacuation procedure and a deep vacuum procedure.

b. Georgia, Refrigeration, Instructor Guide, Vol. IV, 1980.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

o. Ambient temperature
p. Types of vacuum indicators
q. Pressure measurement
r. Inches of mercury measurement
s. Acid
t. Gauges

TASK

RF-16 Installing refrigeration accessories

PERFORMANCE OBJECTIVE

Install in-line accessories according to manufacturer's specifications. (Filter driers, liquid indicators, etc.)

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Absorb/adsorb
b. Back pressure regulators
c. Crankcase pressure regulators
d. Desiccant
e. Drier
f. Liquid line valve
g. Liquid indicator
h. Liquid line filter drier
i. Moisture indicator
j. Pump down valve
k. Receiver
l. Suction line accumulator
m. Suction line filter-drier
n. Vibration eliminator
o. Function of accessories
p. Installation of accessories

Provide Demonstration On:

Correct procedures for removing and replacing all components of the refrigeration system

Provide Practical Application On:

a. Installing a liquid indicator with flare-fittings
b. Installing a filter-drier with sweat fittings
c. Installing a capillary tube into a filter-drier
d. Pumping the system down
e. Testing leaks

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

A/Vs:

Georgia, slide/tape REF-16, "Installing Refrigeration Accessories"

Student Manuals:

a. Georgia, Refrigeration, Unit REF-16
b. Copeland
c. Carrier, GTR Manuals

Tools and Equipment:

a. Refrigeration system
b. Flaring tools
c. Assorted hand tools
d. Torch

(Continued on back)

CLASSROOM HOURS	6

EVALUATION (RF-16)

a. Given a refrigeration unit and accessories and proper tools, the student will remove and replace various accessories properly and check for leaks.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

e. Refrigeration system components
f. Gauge and manifold set
g. Leak detector
h. Safety glasses

TASK

RF-17 Testing for leaks

PERFORMANCE OBJECTIVE

Test for leaks by using soap bubbles, halide torch and an electronic dectector.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Methods used in leak detection
b. Pressurizing the system
    1. Freon
    2. Dry nitrogen
c. Devices used in detecting leaks
d. Effect of leaks on the vacuum
e. Repairing leaks

Provide Demonstration On:

a. Testing for leaks using various methods
b. Repairing leaks

Provide Practical Application On:

Leak testing with various leak testing devices

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

A/Vs:

Georgia, slide/tape REF-17, "Testing for Leaks"

Student Manuals:

a. Georgia, Refrigeration, Unit REF-17
b. Copeland
c. Carrier, GTR Manuals

Tools and Equipment:

a. Refrigeration system
b. Freon and dry nitrogen
c. Leak detectors
d. Gauges and manifold set
e. Assorted hand tools
f. Safety glasses

CLASSROOM HOURS 6

EVALUATION (RF-17)

Given the proper equipment and tools, the student will test for leaks using 1) the "soap bubble" method, 2) a halide torch, 3) an electronic detector.

TASK

RF-18 Charging the system

PERFORMANCE OBJECTIVE

Charge a refrigeration system by vapor and by liquid.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Handling refrigerants
b. Nameplate data
c. Charging methods
   1. Sight glass method
   2. Frost back method
   3. Vapor charging
   4. Liquid charging
   5. Weigh in method
   6. Ambiant temperature method
   7. Super heat method
d. Manufacturer's charts for charging procedures
e. Capillary and T.E.V. systems

Provide Demonstration On:

Various charging methods

Provide Practical Application On:

Charging the refrigeration system (Capillary and T.E.V. systems)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

A/Vs:

a. Georgia, slide/tape REF-18, "Charging the System"
b. Westinghouse, STV-GS1

Student Manuals:

a. Georgia, Refrigeration, Unit REF-18
b. Copeland
c. Carrier, GTR Manuals

Tools and Equipment:

a. Refrigeration systems
b. Manifold and gauge set
c. Freon
d. Thermometer
e. Assorted hand tools

(Continued on back)

CLASSROOM HOURS 18

EVALUATION (RF-18)

a. Given proper equipment and materials, the student will charge a refrigeration system using the vapor method, the liquid method and the ambient temperature method.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

INSTRUCTIONAL MATERIALS

Tools and Equipment:

f. P.T. chart
g. Safety glasses

TASK

RF-19 Testing the compressor

PERFORMANCE OBJECTIVE

Troubleshoot and replace a refrigerator compressor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. A reciprocal compressor
b. Rotary compressor
c. Centrifugal compressor
d. Screw type compressor
e. Hermetic compressor
f. Semi-hermetic compressor
g. Open type compressor
h. Testing the compressor
i. Diagnosing problems in compressors

Provide Demonstration On:

a. Compressor types
b. Troubleshooting and replacement procedures

Provide Practical Application On:

Diagnosing problems and repairing various compressors

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

A/Vs:

a. Georgia, slide/tape REF-19, "Testing the Compressor"
b. Carrier, slide/tape GTR-3 and GTR-9

Student Manuals:

a. Georgia, Refrigeration, Unit REF-19
b. Copeland
c. Carrier, GTR Manuals

Tools and Equipment:

a. Compressors
b. Electric meters
c. Manifold and gauge set
d. Assorted hand tools
e. Refrigerant
f. Safety glasses

CLASSROOM HOURS 30

EVALUATION (RF-19)

a. Given an open type, semi-hermetic and hermetic compressor and proper tools, the student will diagnose problems in the compressors and will remove and replace the faulty compressors.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

RF-20 Troubleshooting condensers

PERFORMANCE OBJECTIVE

Diagnose and replace faulty condensers.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Air cooled condenser (natural draft)
b. Air cooled condenser (forced draft)
c. Air cooled condenser (forced air, remote)
d. Water cooled condenser (shell and tube)
e. Water cooled condenser (tube within a tube)
f. Water cooled condenser (evaporative)
g. Piping layouts
h. Diagnosing condenser problems

Provide Demonstration On:

a. Various types of condensers
b. Troubleshooting techniques
c. Replacement procedures

Provide Practical Application On:

a. Troubleshooting problems in various types of condensers
b. Removal and replacement of condensers

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

A/Vs:

Carrier, slide/tape, GTR-4

Student Manuals:

a. Georgia, Refrigeration, Unit REF-20
b. Copeland
c. Carrier, GTR Manuals

Tools and Equipment:

a. Various types of condensers
b. Assorted tools
c. Test instruments

CLASSROOM HOURS 15

EVALUATION (RF-20)

a. Given various types of condensers, tools and test equipment, the student will correctly diagnose correct and faulty operation in the condensers and will remove and replace faulty condensers.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

RF-21 Troubleshooting evaporators

PERFORMANCE OBJECTIVE

Diagnose and replace faulty evaporators.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The function of evaporators
b. Fin type evaporators
c. Flooded type evaporators
d. Diagnosing malfunctions
e. Removal and replacement procedures

Provide Demonstration On:

a. Types of evaporators
b. Troubleshooting techniques
c. Replacement procedures

Provide Practical Application On:

a. Troubleshooting problems in various types of evaporators
b. Removal and replacement of evaporators

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

A/Vs:

Carrier, slide/tape, GTR-5

Student Manuals:

a. Georgia, Refrigeration, Unit REF-21
b. Copeland
c. Carrier, GTR Manuals

Tools and Equipment:

a. Refrigeration systems
b. Manifold and gauge set
c. Freon
d. Leak detector
e. Torch and solder
f. Assorted tools

CLASSROOM HOURS

15

EVALUATION (RF-21)

a. Given various types of evaporators, proper tools and equipment, the student will diagnose correct and faulty operation and will repair or remove/replace faulty evaporators as necessary.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

RF-22 Troubleshooting an automatic expansion valve

PERFORMANCE OBJECTIVE

Diagnose and correct malfunctions in automatic expansion valves.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The functioning of A.E.V.
b. Improper adjustment
c. Moisture in the valve
d. Moisture in the bellows or diaphragm
e. Components of the valve
f. Diagnostic techniques
g. Adjustment procedures
h. Replacement procedures

Provide Demonstration On:

a. Diagnostic techniques
b. Adjustment procedures

Provide Practical Application On:

a. Disassembling, inspecting and reassembling A.E.V.
b. Removing, replacing and adjusting A.E.V.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

Student Manuals:

a. Georgia, Refrigeration, Unit REF-22
b. Copeland
c. Carrier, GTR Manuals

Tools and Equipment:

a. Automatic expansion valves
b. Refrigeration system with the A.E.V.
c. Manifold and gauge set
d. Assorted handtools
e. Freon

CLASSROOM HOURS 18

EVALUATION (RF-22)

a. Given a refrigeration system with a faulty automatic expansion valve, the student will diagnose faulty operation in the valve and will repair or remove/ replace the valve as necessary for correct operation.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

RF-23 Troubleshooting capillary tubes

PERFORMANCE OBJECTIVE

Identify, remove and replace or repair faulty capillary tubes.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The function of the capillary system
b. Capillary tube applications
c. Diagnosing faulty operation
d. Removal and replacement procedures
e. Sizing the tube system
f. Type of motors used on the capillary system
g. Correct freon charge

Provide Demonstration On:

a. Properly and improperly functioning capillary systems
b. Removal and replacement procedures

Provide Practical Application On:

a. Diagnosing faulty capillary functioning
b. Using an hydraulic tester
c. Removing and replacing capillary tube systems

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

Student Manuals:

a. Georgia, Refrigeration, Unit REF-23
b. Copeland
c. Carrier, GTR Manuals

Tools and Equipment:

a. Capillary
b. Manifold and gauge set
c. Torch and solder
d. Freon
e. Drier
f. Assorted hand tools

CLASSROOM HOURS 24

EVALUATION (RF-23)

a. Given a refrigeration system with faulty functioning of the capillary tubes, the student will properly diagnose the malfunction and will repair or remove/replace the capillary system.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

RF-24 Troubleshooting thermostatic expansion valves

PERFORMANCE OBJECTIVE

Diagnose, repair or remove/replace faulty thermostatic expansion valves.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of thermostatic expansion valves
b. Location
c. Functioning
d. Sub-cooling
e. Component parts
f. Bulb location and installation
g. External equalizer connection
h. Driers, strainers and accessories
i. Test pressures and dehydration temperatures
j. Determining superheat
k. Malfunctions
l. Repairing the valve

(Continued on back)

Provide Demonstration On:

a. Types of T.E.V.
b. Diagnostic techniques
c. Repair and replacement procedures

Provide Practical Application On:

a. Diagnosing faulty T.E.V. functioning
b. Repair and adjustment procedures
c. Removal and replacement procedures

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

A/Vs:

Georgia, slide/tape REF-24, "Troubleshooting a Thermostatic Expansion Valve"

Student Manuals:

a. Georgia, Refrigeration, Unit REF-24
b. Copeland
c. Carrier, GTR Manuals

Tools and Equipment:

a. T.E.V. refrigerator system
b. Assorted T.E.V.
c. Manifold and gauge set
d. Freon
e. Drier
f. Assorted tools

CLASSROOM HOURS 9

EVALUATION (RF-24)

a. Given a refrigeration system with faulty functioning of the thermostatic expansion valve, the student will properly diagnose the malfunction and will repair or remove/replace the T.E.V.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

m. Valve setting
n. Evaporating temperature
o. Thermostatic charge
p. Internal and external equalizer
q. Pumping down the T.E.V. system

TASK

RF-25 Troubleshooting the refrigeration system

PERFORMANCE OBJECTIVE

Diagnose and repair malfunctions in refrigeration systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Troubleshooting from symptoms
b. Types of compressor failure
c. Types of condenser failure
d. Types of evaporator failure
e. Refrigerant leaks
f. Capillary tube failure
g. Low charge and high charge
h. Non-condensables
i. A.E.B. failure
j. T.E.V. failure
k. Troubleshooting tables

Provide Demonstration On:

Troubleshooting techniques

Provide Practical Application On:

Diagnosing and repairing various problems in refrigeration systems

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse, et al.
c. Delmar, Principles of Refrigeration

Student Manuals:

a. Georgia, Refrigeration, Unit REF-25
b. Copeland
c. Carrier, GTR Manuals

Tools and Equipment:

a. Refrigerator systems
b. Manifold and gauge set
c. Freon
d. Test meters
e. Leak detector
f. Assorted tools

CLASSROOM HOURS

48

EVALUATION (RF-25)

a. When presented with refrigeration systems having malfunctions, the student will accurately diagnose and repair the malfunctions so that the systems are fully operational.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

AC-01 Identifying major components and functions of air conditioning systems

PERFORMANCE OBJECTIVE

Identify types and components of air conditioning systems, their functions and their relation to human comfort.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Window units
b. Split systems
c. Package systems
d. Hydronic systems
e. Solar systems
f. Methods of heat removal
    1. Convection
    2. Radiation
    3. Evaporation
g. Factors effecting comfort
    1. Temperature
    2. Humidity
    3. Cleanliness
    4. Distribution
h. Tables of comfort zones

Provide Demonstration On:

a. Use of amprobe
b. Use of VOM

Provide Practical Application On:

a. Inspecting various types of systems and components
b. Recording nameplate data to gain familiarity with equipment

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Althouse
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, slide/tape AC-01a, "Demonstrate a Knowledge of Air Conditioning Systems"

Student Manuals:

Georgia, Air Conditioning, Unit AC-01

Tools and Equipment:

a. Window units
b. Central system components
c. Hydronic system
d. Solar components

CLASSROOM HOURS 10

EVALUATION (AC-01)

a. When presented with the various components and systems covered in this unit, the student will correctly identify all equipment and accurately describe the function of each major component.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

AC-02 Applying basic air principles

PERFORMANCE OBJECTIVE

Determine air properties through use of psychrometric charts and a psychrometer.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Basic psychrometric chart
b. Basic text for psychrometric chart
c. Principles of psychrometrics
    1. Wet bulb
    2. Dry bulb
    3. Relative humidity
    4. Dew point
    5. Grains of moisture
d. Sample problems to locate unknown properties of psychrometric chart

Provide Demonstration On:

a. Use of psychrometric chart
b. How to plot unknown properties on the chart

Provide Practical Application On:

Reading wet and dry bulb temperatures using a sling psychrometer

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Althouse
c. Prentice-Hall, Refrigeration and Air Conditioning
d. Carrier Corp., Carrier Manual

A/Vs:

Georgia, slide/tape AC-02a, "Applying Basic Air Principles"

Student Manuals:

Georgia, Air Conditioning, Unit AC-02

Tools and Equipment:

a. Psychrometric chart
b. Sling psychrometer
c. Wet bulb and dry bulb thermometers

CLASSROOM HOURS 10

EVALUATION (AC-02)

a. Being familiar with the definition of psychrometric terms and the psychrometric chart, the learner will plot unknown values on the chart.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

AC-03 Calculating heat loads

PERFORMANCE OBJECTIVE

Calculate heat loads by the use of charts and Manual "J" tables.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Terminology of graphs and charts
b. Reading dimensions from floor plans
c. Use of Manual "J" tables to find total heat loss for a given room or residence

Provide Demonstration On:

a. Heat flow resistance
b. Reading graphs and tables

Provide Practical Application On:

Calculating heat loss and heat gain from a house plan

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, slide/tape AC-03a, "Calculating Heat Loads"

Student Manuals:

Georgia, Air Conditioning, Unit AC-03

Tools and Equipment:

House floor plan

CLASSROOM HOURS 28

EVALUATION (AC-03)

a. Given a residence floor plan, the learner will use tables and charts to find the total heat loss for a given conditioned space.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

AC-04 Applying principles of air movement

PERFORMANCE OBJECTIVE

Calculate and measure air flow through air conditioning duct work.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The function of a duct system
b. Measuring air velocity
    1. Static pressure
    2. Velocity pressure
    3. Total pressure
    4. CFM
c. Measurement instruments
    1. U-tube manometer
    2. Anemometer
d. Duct system design

Provide Demonstration On:

a. Use of the manometer
b. Use of the aneometer

Provide Practical Application On:

a. Taking static pressure readings using the manometer
b. Taking total pressure readings
c. Calculate feet per minute air flow using the anemometer

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, slide/tape AC-04, "Applying Principles of Air Movement"

Student Manuals:

Georgia, Air Conditioning, Unit AC-04

Tools and Equipment:

a. Operational duct work
b. U-tube manometer
c. Anemometer
d. Stop watch

CLASSROOM HOURS

15

EVALUATION (AC-04)

a. Given an operational duct system, the student will correctly measure static, velocity and total pressures and will calculate CFM using correct meters and procedures.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

AC-05 Servicing air filtering systems

PERFORMANCE OBJECTIVE

Remove and replace or clean air filters on various types of air conditioning systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Purpose of filtering
b. Various types of filters
    1. Wet
    2. Dry
c. Location of filters
d. When and how to remove and replace dirty filters
e. Electronic air cleaners
    1. Ionizing electrostatic
    2. Charge media

Provide Demonstration On:

a. Types of filters
b. The effect of a dirty filter on air flow

Provide Practical Application On:

a. Servicing both a throw-away filter and a cleanable metal filter
b. Operating and troubleshooting an electronic air filtering system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Althouse
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, slide/tape AC-05a, "Identifying Air Filtering Systems"

Student Manuals:

Georgia, Air Conditioning, Unit AC-05

Tools and Equipment:

a. Filters
b. Hand tools
c. Air conditioning systems
d. Electronic air filtering equipment

CLASSROOM HOURS 15

EVALUATION (AC-05)

a. Given a variety of air conditioning equipment, the student will correctly remove and replace or clean and replace air filters.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

AC-06 Installing a window air conditioning unit

PERFORMANCE OBJECTIVE

Install a window air conditioning unit according to manufacterer's specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Air conditioner parts
b. Window parts
c. Tools to be used
d. Installation checkpoints
    1. Adequate wiring and fuses
    2. Drainage slope
    3. Secure placement
    4. Window lock
    5. Air leaks
    6. Filter
    7. Correct operation of unit
e. Annual maintenance

Provide Demonstration On:

Correct installation procedures

Provide Practical Application On:

Installing a window air conditioner in a mock-up window

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Althouse
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, slide/tape AC-06, "Installation of a Window Unit"

Student Manuals:

Georgia, Air Conditioning, Unit AC-06

Tools and Equipment:

a. Assorted hand tools
b. Permagum
c. Safety-glasses
d. Window air conditioner
e. Mock-up window

CLASSROOM HOURS

6

EVALUATION (AC-06)

a. Given a window air conditioning unit and assorted tools, the student will install the unit in a window according to manufacturer's specifications and according to standard practice.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

AC-07 Performing pre-season start up maintenance on window air conditioning units

PERFORMANCE OBJECTIVE

Inspect and perform pre-season start up maintenance for an air conditioning window unit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. When and why to perform pre-season start up maintenance
b. Typical problems
    1. Rotten wood around window
    2. Cracks in seals and windows
    3. Water leaks
    4. Dirty filter
    5. Dirty coils
    6. Tilt of unit
    7. Condition of braces
    8. Condition of receptacle and cord

(Continued on back)

Provide Demonstration On:

Routine procedures and special problems

Provide Practical Application On:

Performing a pre-season start up maintenance on a window unit

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Althouse
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, slide/tape AC-07, "Performing Pre-Season Start-Up"

Student Manuals:

Georgia, Air Conditioning, Unit AC-07

Tools and Equipment:

a. Assorted hand tools
b. Seals, filters, permagum
c. A window unit in need of pre-season maintenance

CLASSROOM HOURS

6

EVALUATION (AC-07)

a. Given a window air conditioning unit in need of pre-season maintenance, the student will perform pre-season maintenance according to the steps in this unit.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

INSTRUCTIONAL ACTIVITIES (continued)

Provide Information On:

c. Maintenance steps
    1. Remove unit
    2. Oil fan motor
    3. Wrap fan motor in plastic
    4. Clean coils
    5. Straighten fins
    6. Clean evaporator drains
    7. Repair bracing
    8. Tilt unit properly
    9. Repair rotten wood
    10. Repair or replace damaged or missing seals
    11. Reinstall unit
    12. Clean filter
    13. Repair cord
    14. Repair receptacle
    15. Start up and run
    16. Check inlet and outlet temperatures
    17. Repair water leaks
    18. Clean area
    19. Inform customer of maintenance procedures

TASK

AC-08 Troubleshooting compressor burnout in window air conditioners

PERFORMANCE OBJECTIVE

Accurately diagnose a burned out compressor in a window air conditioner and replace with a functioning compressor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of burnout
b. Causes of burnout
c. Diagnosing burnout
d. Acidic oil
e. Replacing a burned out compressor
f. Bleeding the refrigerant
g. Removing and replacing drier or filter and capillary tubes
h. Flushing the evaporator and condenser
i. Evacuating the system
j. Charging the system

Provide Demonstration On:

a. Correct use of test instruments
b. Changing out compressors
c. Evacuating and charging the system

Provide Practical Application On:

a. Diagnosing different types of burnout
b. Replacement of a burned out compressor in a window unit

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Althouse
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, slide/tape AC-08a and AC-08b, "Troubleshooting Compressor Burn Out in a Window Air Conditioner"

Student Manuals:

Georgia, Air Conditioning, Unit AC-08

Tools and Equipment:

a. Burned out and functional compressors
b. VOM, amprobe
c. Vacuum pump
d. Freon
e. Assorted hand tools
f. Compressor test cord
f. Capillary tubes
h. Filter/drier

CLASSROOM HOURS 18

EVALUATION (AC-08)

a. Given a window air conditioner with a burned out compressor, the student will accurately diagnose the nature of the burnout and will replace the burnout with a functional compressor. Replacement will include flushing, evacuation and recharging of the system.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

AC-09 Evacuating and charging window air conditioners

PERFORMANCE OBJECTIVE

Evacuate and charge a window air conditioner using both the temperature, touch and pressure method and the Dial-a-charge method.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. When evacuation and charging are performed
b. Removing all the freon
c. Evacuating the system to 500 microns
d. Breaking the vacuum to zero PSIG with freon vapor
e. Charging the system by the coil temperature and Dial-a-charge methods
f. Checking the system for peak performance
g. Possible safety hazards

Provide Demonstration On:

a. Use of the vacuum pump
b. Charging the system with freon
c. Recognizing when a system is fully charged

Provide Practical Application On:

Evacuating and charging a window unit using the temperature, pressure and touch method and the Dial-a-charge method

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Althouse
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, Unit AC-09a and AC-09b, "Evacuating and Charging a Window Air Conditioner"

Student Manuals:

Georgia, Air Conditioning, Unit AC-09

Tools and Equipment:

a. A window air conditioner to be evacuated and charged
b. Vacuum pump and gauges
c. Freon
d. Thermometers
e. Drier
f. Hand tools
g. Dial-a-charge
h. Shrader valves

CLASSROOM HOURS

18

EVALUATION (AC-09)

a. Given a window air conditioner unit, freon, vacuum pump, gauges and the proper tools, the student will evacuate and recharge the system using both the temperature, pressure and touch method and the Dial-a-charge method so that the system operates at peak efficiency.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

AC-10 Troubleshooting fans and fan motors

PERFORMANCE OBJECTIVE

Diagnose, remove and replace a defective fan and motor in a window air conditioner.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Use of shaded-pole and PSC motors
b. Reading motor schematics
c. Types of mechanical failure
d. Types of electrical failure
e. Operational symptoms of failure
f. Testing for shorts, opens and grounds using the VOM
g. Using the "direct test" method
h. Removing and replacing faulty motors

Provide Demonstration On:

a. Examples of mechanical and electrical failure in fans and motors
b. Testing with the VOM
c. "Direct test" method

Provide Practical Application On:

a. Using the VOM to diagnose electrical failure in defective fan motors
b. Using the "direct test" to diagnose electrical failure in defective motors
c. Removing and replacing a fan and motor in a window unit

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Althouse
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, slide/tape Unit AC-10a and AC-10b, "Troubleshooting Fans and Fan Motors"

Student Manuals:

Georgia, Air Conditioning, Unit AC-10

Tools and Equipment:

a. Fan motors with various defects
b. Window air conditioner unit
c. Replacement fan motor
d. Direct test leads
e. VOM, Amprobe
f. Assorted hand tools

CLASSROOM HOURS 9

EVALUATION (AC-10)

a. Given a window air conditioning unit with a faulty fan motor, the student will correctly diagnose the nature of the fault and will remove and replace the fan motor so that the unit operates properly.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

AC-11 Troubleshooting mechanical problems in window air conditioner refrigeration cycle

PERFORMANCE OBJECTIVE

Accurately diagnose and correct mechanical problems in the refrigeration cycle of window air conditioners.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The most common problems
b. External indicators
   1. Dirty evaporator or condenser
   2. Air temperature drop across evaporator
   3. Evaporator temperature
   4. Suction line temperature
   5. Discharge line temperature
   6. Condenser liquid line temperature
   7. Capillary tube temperature

(Continued on back)

Provide Demonstration On:

a. Indicators of proper functioning
b. Entering the refrigeration system
c. Proper use of test instruments

Provide Practical Application On:

Diagnosing and repairing a window air conditioner with a mechanical problem in the refrigeration cycle

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Althouse
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, slide/tape AC-11a, "Troubleshooting Window Air Conditioner Refrigeration Cycle"

Student Manuals:

Georgia, Air Co[illegible]tioning, Unit AC-11

Tools and Equipment:

a. Window air conditioner with refrigeration fault
b. Replacement parts, Shrader valves
c. Freon and gauges
d. Thermometers
e. Torch
f. Air and brushes for cleaning
g. Assorted tools

CLASSROOM HOURS

18

EVALUATION (AC-11)

a. Given the proper test instruments and repair equipment and a window air conditioner unit with a fault in the mechanical refrigeration cycle, the student will accurately diagnose and repair the problem so that the unit operates at peak capacity.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

INSTRUCTIONAL ACTIVITIES (continued)

Provide Information On:

c. Entering the system
    1. Type of service valves
    2. Discharge pressure
    3. Suction pressure
d. Using the refrigeration cycle charts

TASK

AC-12 Troubleshooting a window air conditioner electrical system

PERFORMANCE OBJECTIVE

Correctly diagnose and repair electrical problems in window air conditioning units.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Identifying all electrical components
b. Reading wiring diagrams
c. Testing components with the VOM and amprobe
    1. Fan motor
    2. Compressor
    3. Mainswitch
    4. Thermostat
    5. Overload
    6. Capacitors
d. Checking line voltage
e. Checking receptacle and wiring
f. Checking fuses

Provide Demonstration On:

Testing with the amprobe and VOM

Provide Practical Application On:

Diagnosing and repairing electrical problems in window air conditioner units

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Althouse
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, slide/tape AC-12, "Troubleshooting a Window Air Conditioning Electrical System"

Student Manuals:

Georgia, Air Conditioning, Unit AC-12

Tools and Equipment:

a. Window air conditioning units with electrical faults
b. VOM, Amprobe
c. Assorted tools

CLASSROOM HOURS 18

EVALUATION (AC-12)

a. Given a number of window air conditioners with various electrical problems, the student will accurately diagnose and repair each problem.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

AC-13 Installing condensate drains

PERFORMANCE OBJECTIVE

Design and install condensate drains on various types of air conditioning units.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The function of a condensate drain
b. Design considerations
c. The importance of traps
d. Cutoff switches
e. Gravity flow and lift pumps
f. Use of plastic pipe
g. Use of metal pipe
h. Fittings and joints

Provide Demonstration On:

Types of condensate drains

Provide Practical Application On:

a. Designing drains for different types of air conditioning units
b. Installing a condensate drain

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Althouse
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, slide/tape AC-13a, "Installing Condensate Drain"

Student Manuals:

Georgia, Air Conditioning, Unit AC-13

Tools and Equipment:

a. PVC or plastic drain pipe and fittings
b. Condensate pump
c. Evaporator unit
d. Assorted tools
e. PVC pipe glue

CLASSROOM HOURS 6

EVALUATION (AC-13)

a. Given a heating/air conditioning unit of the upflow design, the student will design and install a condensate drain with an overflow cutoff switch and lift pump.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV. 1980.

TASK

AC-14 Installing residential and mobile home package air conditioning units

PERFORMANCE OBJECTIVE

Install, wire and charge a residential package air conditioning unit and a mobile home package air conditioning unit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of design
b. Air and water cooled
c. Site selection
d. Ducts and air registers
e. Air and service clearances
f. Foundation and mounting
g. Condensate drain
h. Flashing
i. Insulation
j. Vapor barriers
k. Charging the system

Provide Demonstration On:

a. Examples of typical installations
b. Special problems that may be encountered

Provide Practical Application On:

a. Having the student install a residential unit
b. Having the student install a mobile home unit

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Althouse
c. Prentice-Hall, Refrigeration and Air Conditioning

A/Vs:

Georgia, slide/tape AC-14a, "Installing Package Unit (Residential and Mobile Home)"

Student Manuals:

Georgia, Air Conditioning, Unit AC-14

Tools and Equipment:

a. Residential package air conditioner unit
b. Mobile home package air conditioner unit
c. Duct materials
d. Wiring materials
e. Refrigerant
f. Assorted hand tools and supplies

CLASSROOM HOURS

6

EVALUATION (AC-14)

a. Given the appropriate equipment and supplies, the student will install, charge and connect a residential and a mobile home package air conditioning unit according to manufacturer's instructions and standard practice. The installed units will be fully operational.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

AC-15 Installing split system air conditioning units

PERFORMANCE OBJECTIVE

Install, wire and charge a split system air conditioning unit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Components of a split system
b. Zoning ordinances
c. Noise control
d. Installing the condenser
    1. Location
    2. Foundation
    3. Refrigeration lines
    4. Wiring
    5. Testing the charge
e. Installing the connecting lines
    1. Soft copper tubing
    2. Hard copper tubing (precautions)
    3. Type of solder

(Continued on back)

Provide Demonstration On:

a. Types of split systems and their components
b. Typical installation procedures

Provide Practical Application On:

Installing a complete split system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Althouse
c. Prentice-Hall, Refrigeration and Air Conditioning
d. Doolin

A/Vs:

Georgia, slide/tape AC-15a, "Installing Split System"

Student Manuals:

Georgia, Air Conditioning, Unit AC-15

Tools and Equipment:

a. Condensing unit
b. Evaporator unit with coil section
c. Line set
d. Freon
e. Assorted tools
f. Wiring

CLASSROOM HOURS 18

EVALUATION (AC-15)

a. Given a split air conditioning system, appropriate supplies and tools, the student will install, wire and charge (as necessary) the system according to manufacturer's specifications and standard practice so that the unit is fully operational.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

INSTRUCTIONAL ACTIVITIES (continued)

Provide Information On:

    4. Soft, pre-charged tubing
    5. Use of filter-driers
f. Installing the inside unit
g. Wiring the system
h. The thermostat
i. Fuses

TASK

AC-16 Installing add-on split air conditioning systems

PERFORMANCE OBJECTIVE

Install, wire and charge an add-on split system air conditioning unit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Installing the outside unit
   1. Zoning ordinances
   2. Noise control
   3. Location
   4. Foundation
   5. Refrigerant lines
   6. Wiring
   7. Testing the charge
b. Installing the indoor unit
   1. Matching to existing equipment
   2. Power wiring and disconnect
   3. Thermostat
   4. Condensate drain
   5. Filters
c. Installing the connecting tubing
d. Checking the charge

Provide Demonstration On:

a. Types of add-on systems
b. Properly installed systems

Provide Practical Application On:

Installing an add-on split system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse
b. Delmar, Principles of Air Conditioning
c. Prentice-Hall, Refrigeration and Air Conditioning
d. Doolin

A/Vs:

Georgia, slide/tape AC-16, "Installing Add-on Split Systems"

Student Manuals:

Georgia, Air Conditioning, Unit AC-16

Tools and Equipment:

a. Add-on split system components
b. Refrigerant tubing
c. Wiring
d. Refrigerant and gauges
e. Assorted tools
f. Upflow type furnace

CLASSROOM HOURS 18

EVALUATION (AC-16)

a. Given an upflow or a counter flow type furnace, add-on split system air conditioning components, appropriate tools and supplies, the student will install the add-on split system air conditioning components, including wiring and charging the system according to the manufacturer's specifications, so that the system is fully operational.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

AC-17 Troubleshooting compressor burnout

PERFORMANCE OBJECTIVE

Diagnose and replace a burned out air conditioner compressor.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Mechanical and electrical causes of burnout
b. Finding electrical problems
    1 Power supply
    2. Control circuit
    3. Internal overload
    4. Starting components
    5. Low voltage
    6. Run capacitor
    7. Fan motor
    8. Compressor circuits
c. Finding mechanical problems
    1. High and low side pressure

(Continued on back)

Provide Demonstration On:

a. Testing a motor-compressor electrically
b. Diagnosing mechanical failures
c. Cleanout procedures after burnout

Provide Practical Application On:

a. Diagnosing various types of compressor burnout
b. Removing and replacing a burned out compressor

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, *Principles of Air Conditioning*
b. Althouse
c. Prentice-Hall, *Refrigeration and Air Conditioning*
d. Doolin

A/Vs:

Georgia, slide/tape Unit AC-17a, "Troubleshooting Compressor Burnout"

Student Manuals:

Georgia, *Air Conditioning*, Unit AC-17

Tools and Equipment:

a. Burned out compressor
b. Air conditioning unit
c. Replacement compressor
d. Vaccum pump, freon, gauges, manifold
e. VOM, Volt-amp meter
f. Assorted tools

CLASSROOM HOURS

18

EVALUATION (AC-17)

a. Given the necessary tools and equipment, the student will accurately diagnose various types of compressor burnout and will remove and replace a compressor in an air conditioning unit, including evacuating and charging, so that the unit is fully operational.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

INSTRUCTIONAL ACTIVITIES (continued)

Provide Information On:

2. Vacuum efficient test
3. Oil level
4. Oil acid test
5. Fan motor restriction
6. Condenser restriction
7. Unusual noises

d. Replacing a burned out compressor
e. Flushing the system
f. Installing a new filter-drier
g. Leak checking
h. Evacuating the system
i. Charging the system
j. Checking performance

TASK

AC-18 Troubleshooting fans and fan motors

PERFORMANCE OBJECTIVE

Troubleshoot and repair or replace fans and fan motors.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types and characteristics of fan motors
   1. Shaded pole motor
   2. Split phase motor
   3. Capacitor start motor (CS)
   4. Permanent split capacitor motor (PSC)
   5. Capacitor start/run motor (CSR)
   6. Three phase motor

b. Diagnosing problems
   1. Voltage
   2. Electrical connections
   3. Starting components
   4. Motor windings
   5. Bearings
   6. Mounting bolts
   7. Blades
   8. Pulleys and belts

c. Removing and replacing motor

Provide Demonstration On:

a. Different types of motors
b. Diagnostic techniques
c. Typical types of motor failure

Provide Practical Application On:

Diagnosing, removing and replacing motors from evaporators and condensers

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Althouse
c. Prentice-Hall, Refrigeration and Air Conditioning
d. Doolin

A/Vs:

Georgia, slide/tape AC-18a, "Troubleshooting Fans and Fan Motors"

Student Manuals:

Georgia, Air Conditioning, Unit AC-18

Tools and Equipment:

a. Electrically and mechanically faulty fan motors
b. Evaporator and condenser, replacement motors
c. VOM, amprobe
d. Assorted tools

CLASSROOM HOURS 9

EVALUATION (AC-18)

a. Given the necessary tools and equipment, the student will accurately diagnose different types of mechanical and electrical failure in evaporator and condenser fans and fan motors, and will remove and replace a fan and motor from a condenser and an evaporator so that the unit is fully operational.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

AC-19 Performing pre-season start up and air conditioner service

PERFORMANCE OBJECTIVE

Inspect and perform pre-season start up maintenance on air conditioning units.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. When and why perform pre-season start up
b. Servicing the outside unit
    1. Voltage check
    2. Check F.L.A.
    3. Check for loose connections
    4. Compressor oil level
    5. Check freon charge
    6. Leak check
    7. Low and high side pressures
    8. Oil condenser fan motor

(continued on next page)

Provide Demonstration On:

Pre-season start up procedures

Provide Practical Application On:

Giving complete pre-season start up service on an air conditioning split unit

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Althouse
c. Prentice-Hall, Refrigeration and Air Conditioning
d. Doolin

A/Vs:

Georgia, slide/tape AC-19a, "Performing Pre-Season Start Up"

Student Manuals:

Georgia, Air Conditioning, Unit AC-19

Tools and Equipment:

a. Air conditioning system
b. VOM, amprobe
c. Freon, gauges
d. Assorted tools

CLASSROOM HOURS 6

EVALUATION (AC-19)

a. Given an air conditioning system, service equipment and tools, the student will perform pre-season maintenance according to procedures covered in this unit.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

INSTRUCTIONAL ACTIVITIES (continued)

Provide Information On:

9. Checking air flow across the condenser

c. Servicing the inside unit
    1. Voltage check
    2. Check fan motor amps, running
    3. Belt tension and condition
    4. Fan motor lubrication
    5. Check air filter
    6. Check fan blades
    7. Check for loose electrical connections
    8. Evaporator air flow
    9. Temperature drop across evaporator
    10. Condensate pump
    11. Functioning of thermostat

TASK

AC-20 Troubleshooting air conditioner refrigeration cycle

PERFORMANCE OBJECTIVE

Diagnose and repair problems in the refrigeration cycle of air conditioners.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Troubleshooting from symptoms
b. Types of compressor failure
    1. Bearing failure
    2. Improper lubrication
    3. Faulty reed valves
c. Refrigerant leaks
d. Metering device malfunction
e. Low charge
f. High charge
g. Non-condensables
h. Determining proper charge
    1. Weigh in method
    2. Ambient temperature method
    3. Evaporator temperature drop method
    4. Superheat method

Provide Demonstration On:

a. Proper use of manifold and gauges in charging
b. Detecting a low and a high charge

Provide Practical Application On:

Charging a system using the four different methods

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Althouse
c. Prentice-Hall, Refrigeration and Air Conditioning
d. Doolin

A/Vs:

Georgia, slide/tape AC-20a and AC-20b, "Troubleshooting Air Conditioners (Refrigeration Cycle)"

Student Manuals:

Georgia, Air Conditioning, Unit AC-20

Tools and Equipment:

a. Air conditioning systems with refrigeration cycle mechanical faults
b. Freon, manifold, gauges
c. VOM, Amprobe
d. Thermometers
e. Assorted tools

CLASSROOM HOURS 12

EVALUATION (AC-20)

a. When presented with air conditioning systems having various mechanical faults in the refrigeration cycle, the student will accurately diagnose the malfunctions and will carry out the necessary repairs so that the systems are fully operational.

b. Gerogia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

AC-21 Troubleshooting air conditioner electrical cycle

PERFORMANCE OBJECTIVE

Diagnose and repair problems in the electrical cycle of air conditioners.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Diagnosing by symptom
b. Checking incoming voltage and wiring
c. Testing air conditioner electrical components
    1. Circuit breaker
    2. Contactor
    3. Fan relay
    4. Transformer
    5. Capacitors
    6. Thermostat
    7. Fan motor
    8. Motor-compressor

Provide Demonstration On:

Correct use of meters for test of components

Provide Practical Application On:

Diagnosing and repairing various electrical problems in air conditioning units

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Althouse
c. Prentice-Hall, Refrigeration and Air Conditioning
d. Doolin

Student Manuals:

Georgia, Air Conditioning, Unit AC-21

Tools and Equipment:

a. Air conditioning systems with faults in the electrical cycle
b. VOM, amprobe
c. Replacement parts
d. Assorted tools

CLASSROOM HOURS 18

EVALUATION (AC-21)

a. When presented with air conditioning systems having various faults in the electrical cycles, the student will accurately diagnose the electrical malfunctions and will carry out the necessary repairs so that the systems are fully operational.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

AC-22 Troubleshooting air conditioner air movement

PERFORMANCE OBJECTIVE

Diagnose and repair problems with air conditioner condenser and evaporator coils and air flow.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Diagnosis by symptom
b. Types of condensers
    1. Air cooled
    2. Round air cooled
    3. Shell and coil water cooled
    4. Shell and tube water cooled
    5. Double pipe water cooled
    6. Evaporative condenser
c. Typical condenser problems
    1. Air flow blockage
    2. Freon leaks

(continued on back)

Provide Demonstration On:

a. Types of condensers and evaporators
b. Typical problems encountered
c. Repair of typical problems

Provide Practical Application On:

Diagnosing and repairing problems in different types of condensers and evaporators

INSTRUCTIONAL MATERIALS

Textbooks:

a. Delmar, Principles of Air Conditioning
b. Althouse
c. Prentice-Hall, Refrigeration and Air Conditioning
d. Doolin

A/Vs:

Georgia, slide/tape AC-22a and AC-22b, "Troubleshooting Air Conditioners (Air Movement)"

Student Manuals:

Georgia, Air Conditioning Unit AC-22

Tools and Equipment:

a. Various types of air conditioning systems
b. Air meter (F.P.M.)
c. Assorted tools

CLASSROOM HOURS 12

EVALUATION (AC-22)

a. When provided with various types of air conditioning systems with air flow problems, the student will accurately diagnose and repair the problems, so that the units are fully operational.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

INSTRUCTIONAL ACTIVITIES (continued)

Provide Information On:

3. Installation location
4. Cooling capacity load
5. Water flow blockage (water cooled)
6. Water leaks (water cooled)

d. Types of evaporators
   1. "A" coil
   2. "H" coil
   3. Sloped coil
   4. Hydronic coil systems

e. Evaporator problems
   1. Freon leaks
   2. Dirty filters or improper filters
   3. Ice accumulation

TASK

AC-23 Applying principles of the heat pump

PERFORMANCE OBJECTIVE

Identify the components and operating principles of different types of heat pump installations.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Principles of heat pump operation
b. How the refrigerant reverses cycle
c. Evaporator and condensor
d. Four way valve
e. The cooling cycle
f. The heating cycle
g. Types of heat pumps

Provide Demonstration On:

Heat pump components and their functions in the system

Provide Practical Application On:

Identifying and inspecting heat pump components

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse
c. Delmar, Principles of Air Conditioning

A/Vs:

Georgia, slide/tape AC-23, "Understanding Principles of the Heat Pump"

Student Manuals:

Georgia, Heat Pumps, Unit AC-23

Tools and Equipment:

a. Various types of heat pumps
b. Heat pump components

CLASSROOM HOURS

12

EVALUATION (AC-23)

The student will correctly identify different types of heat pumps, their components and the flow of refrigerant through the cooling cycle and heating cycle.

TASK

AC-24 Evacuating and charging the heat pump

PERFORMANCE OBJECTIVE

Evacuate and charge a heat pump.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Single stage and two-stage vacuum pumps
b. Purpose of evacuation
c. Evacuation procedure
d. Removing moisture and acid
e. Charging procedures
f. Determining proper freon charge
g. Various charging charts

Provide Demonstration On:

a. Proper evacuating and charging procedures
b. Troubleshooting techniques

Provide Practical Application On:

a. Evacuating and charging a heat pump
b. Diagnosing charge problems

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse
c. Delmar, Principles of Air Conditioning

Student Manuals:

Georgia, Heat Pumps, Unit AC-24

Tools and Equipment:

a. Heat pump
b. Manifold and gauge set
c. Vacuum pump and gauge
d. Freon
e. Assorted tools

CLASSROOM HOURS 12

EVALUATION (AC-24)

Given a heat pump and proper tools and equipment, the student will triple-evacuate and recharge the system according to specification.

TASK

AC-25 Installing a reversing valve

PERFORMANCE OBJECTIVE

Install a reversing valve on a heat pump.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function of the reversing valve
b. Testing the operation of the reversing valve
c. Purpose and operation of the pilot solenoid
d. Removal and replacement procedures
e. Troubleshooting techniques

Provide Demonstration On:

Proper testing, removal and replacement procedures

Provide Practical Application On:

Testing, removing and replacing a reversing valve

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Delmar, Principles of Air Conditioning

Student Manuals:

Georgia, Heat Pumps, Unit AC-25

Tools and Equipment:

a. Reversing valve
b. Heat pump system
c. Torch and solder
d. Vacuum pump and gauges
e. Manifold and gauge set
f. Freon
g. Leak detector
h. Assorted tools

CLASSROOM HOURS 6

EVALUATION (AC-25)

Given a heat pump, a reversing valve and appropriate tools and equipment, the student will install the reversing valve and evacuate and recharge the system so that the heat pump is fully operational.

TASK

AC-26 Tracing the heat pump refrigeration cycle

PERFORMANCE OBJECTIVE

Trace the operation of the heat pump through the refrigeration cycle.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Each component in the refrigeration cycle
b. Condition of the freon at each point in the cycle
c. The inside and outside coils during heating and cooling
d. Troubleshooting techniques

Provide Demonstration On:

Diagrams of heat pump operation during heating and cooling

Provide Practical Application On:

Identifying and inspecting operation of components during heating and cooling

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse
c. Delmar, Principles of Air Conditioning

A/Vs:

Georgia, slide/tape AC-26, "Refrigeration Cycle and Components"

Student Manuals:

Georgia, Heat Pumps, Unit AC-26

Tools and Equipment:

Operational heat pump

CLASSROOM HOURS

12

EVALUATION (AC-26)

Given an operational heat pump, the student will trace the operation of the components through the heating and cooling cycle.

TASK

AC-27 Installing electrical circuits

PERFORMANCE OBJECTIVE

Diagram and install electrical circuits on a heat pump.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Schematic wiring diagrams for heat pumps
b. Different types of design
c. Line voltage
d. Low voltage
e. Supplement heat
f. Guard circuits
g. Thermostats
h. Wiring installation techniques
i. Diagnosing problems

Provide Demonstration On:

a. Schematic wiring diagrams
b. Techniques of installation
c. Testing and troubleshooting

Provide Practical Application On:

a. Reading schematics
b. Wiring a heat pump unit
c. Diagnosing and repairing wiring problems

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse
c. Delmar, Principles of Air Conditioning

A/Vs:

Georgia, slide/tape AC-27, "Inspecting Electrical Circuits"

Student Manuals:

Georgia, Heat Pumps, Unit AC-27

Tools and Equipment:

a. Schematics
b. Heat pumps
c. Wiring supplies
d. Assorted hand tools

CLASSROOM HOURS

12

EVALUATION (AC-27)

Given an unwired heat pump, a wiring schematic and appropriate supplies, tools and equipment, the student will properly wire the unit and components according to the schematic and manufacturer's specifications.

TASK

AC-28 Adjusting and repairing defrost controls

PERFORMANCE OBJECTIVE

Adjust and repair the defrost controls on a heat pump.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The cause of frosting
b. Three basic steps of the defrost cycle
c. Methods of frost detection
d. Adjusting and repairing defrost controls
e. Different methods of defrost
f. Troubleshooting techniques

Provide Demonstration On:

a. Sequence of operation on several types of frost detection devices
b. Adjustment and repair procedures

Provide Practical Application On:

a. Using different frost detection methods
b. Adjusting and repairing defrost controls

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse
c. Delmar, Principles of Air Conditioning

A/Vs:

Georgia, slide/tape AC-28, "Adjusting and Repairing Defrost Controls"

Student Manuals:

Georgia, Heat Pumps, Unit AC-28

Tools and Equipment:

a. Heat pumps with different types of defrost methods
b. Assorted tools

CLASSROOM HOURS

6

EVALUATION (AC-28)

Given various types of heat pumps with malfunctioning defrost control devices, the student will adjust or repair the defrost controls so that the systems are fully operational.

TASK

AC-29 Installing package heat pumps

PERFORMANCE OBJECTIVE

Install, wire and check out a package heat pump system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Design of package units
b. Types of package units
c. Air flow systems
d. Supplementary heat coil installation
e. Installation techniques
f. Piping
g. Electrical connections
h. Diagnosing problems

Provide Demonstration On:

a. Different types of packing units
b. Proper installation techniques

Provide Practical Application On:

Installing, wiring and troubleshooting package units

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse
c. Delmar, Principles of Air Conditioning

A/Vs:

Georgia, slide/tape AC-29, "Installing Package Heat Pumps"

Student Manuals:

Georgia, Heat Pumps, Unit AC-29

Tools and Equipment:

a. Package heat pumps
b. Copper tubing and fittings
c. Torch and solder
d. Freon, leak detector, vacuum pump
e. Assorted tools, gauges and instruments

CLASSROOM HOURS

9

EVALUATION (AC-29)

a. Given a package heat pump and proper tools and equipment, the student will install the unit according to manufacturer's specifications. The unit must be fully operational.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

AC-30 Installing split-system heat pumps

PERFORMANCE OBJECTIVE

Install, wire and check out a split-system heat pump.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. System components
b. Indoor unit
c. Outdoor unit
d. Connecting tubing
e. Electrical controls
f. Outside unit location
g. Use of silver solder
h. Duct work requirements
i. Power wiring and fusing
j. Thermostat
k. Charging the system

Provide Demonstration On:

a. Types of split-system components
b. Proper installation techniques
c. Troubleshooting techniques

Provide Practical Application On:

Installing, wiring and troubleshooting a split-system heat pump

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse
c. Delmar, Principles of Air Conditioning

A/Vs:

Georgia, slide/tape AC-30, "Installing Split System Heat Pumps"

Student Manuals:

Georgia, Heat Pumps, Unit AC-30

Tools and Equipment:

a. Split-system heat pump
b. Assorted hand tools, gauges and instruments
c. Copper tubing and fittings
d. Torch and solder
e. Freon, leak detector, vacuum pump

CLASSROOM HOURS 9

EVALUATION (AC-30)

a. Given a split-system heat pump system and proper tools and equipment, the student will install, charge and wire the system according to manufacturer's specifications. The pump system must be fully operational.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

HE-01 Applying principles of electric furnaces and controls

PERFORMANCE OBJECTIVE

Demonstrate a knowledge of the components and principles involved in the operation of electric furnaces and controls.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Power sources
b. Transformers
c. Thermostats
d. Heating elements
e. Sequencers
f. Sequence of operation
g. Fan motors
h. Limit controls
i. Fusible links
j. Fan relays
k. Operation of heating systems

Provide Demonstration On:

Checking the operation of a system using proper test instruments

Provide Practical Application On:

Inspecting various types of furnaces in operation

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse
b. Cooper
c. Manufacturer's instruction and operation manuals

A/Vs:

a. Georgia, slide/tape HE-01, "Applying Principles of Electric Furnaces and Controls"
b. Carrier

Student Manuals:

Georgia, Heating, Unit HE-01

Tools and Equipment:

a. Furnaces
b. Test meters
c. Assorted tools

CLASSROOM HOURS 18

EVALUATION (HE-01)

a. Given an electric furnace, the student will list all components and their purpose of operation.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

HE-02 Installing electric furnaces

PERFORMANCE OBJECTIVE

Install an electric furnace using manufacturer's installation instructions and wiring diagrams.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Positioning of electric furnaces
b. Furnace clearance
c. Type of thermostat and wiring
d. Type and size of power wiring
e. Checking manufacturing installation instructions
f. Reading wiring diagrams
g. Local and state codes

Provide Demonstration On:

Proper and inproper installation techniques

Provide Practical Application On:

a. Positioning furnaces
b. Checking clearances
c. Connecting to duct work
d. Pulling and connecting power sources
e. Installing thermostats and connects
f. Testing units for proper operation

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Althouse
c. Cooper
d. Manufacturer's installation instructions

A/Vs:

Carrier

Student Manuals:

Georgia, Heating, Unit HE-02

Tools and Equipment:

a. Furnace unit
b. Sheet metal tools
c. Assorted tools
d. Wiring for line and control

CLASSROOM HOURS 12

EVALUATION (HE-02)

a. Given an electric furnace and proper tools and equipment, the student will install an electric furnace according to manufacturer's specifications and local and state codes.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

HE-03 Troubleshooting electric furnaces

PERFORMANCE OBJECTIVE

Diagnose and repair malfunctions in electric furnaces so that the units are fully operational.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Troubleshooting from symptoms
b. Incoming voltage and wiring
c. Circuit breaker or fuse
d. Reading schematics
e. Thermostat operation
f. First sequencer
g. First heater
h. Limit switch
i. Pulling the heater strip
j. The fusible link
k. Second and third sequencer
l. Second and third heater

Provide Demonstration On:

a. An electric furnace in operation
b. Troubleshooting a furnace by the process of elimination and sequence of operation

Provide Practical Application On:

Diagnose and repair various problems in different types of electric furnaces.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Manufacturer's instructions for electric furnaces
b. Cooper

A/Vs:

a. Georgia, slide/tape HE-03, "Troubleshooting Electric Furnaces"
b. Carrier

Student Manuals:

Georgia, *Heating*, Unit HE-03

Tools and Equipment:

a. Different types of electric furnaces having various malfunctions
b. Test meters
c. Replacement parts
d. Assorted hand tools

CLASSROOM HOURS 18

EVALUATION (HE-03)

a. Given several electric furnaces with different malfunctions, the student will correctly diagnose and repair the problems so that the units are fully operational.

b. Georgia, Electro-Mechancial, Instructor Guide, Vol. IV, 1980.

TASK

HE-04 Applying gas fuel combustion and safety principles

PERFORMANCE OBJECTIVE

Demonstrate a knowledge of the principles of gas fuel combustion and safe handling practices.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Natural gas
b. Liquid petroleum
c. Mixed gas
d. Carbon monoxide
e. Manufactured gas
f. Specific gravity
g. Explosive limits
h. Checking for leaks
    1. Odor
    2. Corrosion in gas lines
    3. Using soap bubbles
i. Procedures to follow if gas leak is suspected
j. Venting procedures
k. Fire safety codes

Provide Demonstration On:

a. Using the pressure test gauge
b. Using a combustion test kit
c. Checking for leaks

Provide Practical Application On:

a. Testing a gas furnace and related piping for leaks
b. Adjusting a furnace to insure proper combustion
c. Demonstrating venting procedures

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse
b. Carrier, Gas Piping and Combustion
c. Cooper

A/Vs:

Georgia, slide/tape HE-04a, "Applying Gas Fuel Combustion and Safety Principles"

Student Manuals:

Georgia, Heating, Unit HE-04

Tools and Equipment:

a. Pressure test gauge
b. Combustion test kit
c. Different types of gas furnaces
d. Soap bubbles
e. Assorted tools

CLASSROOM HOURS

9

EVALUATION (HE-04)

a. Given a gas furnace and test equipment, the student will test the gas pressure in the system, test the combustion and use the soap bubble test for leaks.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

HE-05 Identifying major components and functions of gas heating systems

PERFORMANCE OBJECTIVE

Identify types and components of gas heating systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Components of gas furnaces
    1. Gas valves
    2. Pressure regulator
    3. Pilot safety
    4. Burner assembly
    5. Heat exchanger
    6. Draft hood
    7. Basso switch
    8. Controls
    9. Fan motor
    10. Thermocouple
    11. Heat exchanger
    12. Flue
b. Types of furnaces
    1. Downflow
    2. Upflow
    3. Horizontal
    4. Low boy
c. Testing instruments

Provide Demonstration On:

a. The function of each component
b. Using test instruments to test each component

Provide Practical Application On:

Testing each component on an operational furnace

INSTRUCTIONAL MATERIALS

Textbooks:

a. Cooper
b. Carrier Heating Manual

A/Vs:

a. Georgia, slide/tape HE-05a and HE-05b, "Understanding Basic Gas Systems"
b. Carrier

Student Manuals:

Georgia, Heating, Unit HE-05

Tools and Equipment:

a. Volt meter
b. Ohmmeter
c. Small hand tools
d. Water manometer

CLASSROOM HOURS 6

EVALUATION (HE-05)

When presented with the various gas furnace components and systems covered in this unit, the student will correctly identify all equipment and accurately describe the function of each unit and component.

TASK

HE-06 Checking gas sources

PERFORMANCE OBJECTIVE

Check gas sources and determine the rate of consumption.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Slack tube manometer
b. Bacharach manometer
c. Dial manometer
d. Installing manometers
e. Reading manometers
f. Checking gas flow and BTU imput
g. Reading gas meters
h. Problems with gas meters

Provide Demonstration On:

a. Hooking up a water manometer
b. Reading a gas meter and determining hourly gas input

Provide Practical Application On:

a. Adjusting appliance regulator
b. Determining cubic feet consumed per hour

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse
b. Carrier Heating Manual

A/Vs:

a. Georgia, slide/tape HE-06, "Checking Gas Sources"
b. Carrier

Student Manuals:

Georgia, Heating, Unit HE-06

Tools and Equipment:

a. Watch with minute hand
b. Water manometer
c. Small hand tools
d. Operational gas furnace

CLASSROOM HOURS 6

EVALUATION (HE-06)

a. Given an operational gas furnace, appropriate tools and equipment, the student will determine the rate of gas flow.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

HE-07 Applying gas piping principles

PERFORMANCE OBJECTIVE

Calculate size and properly install house piping for gas heating systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Factors that determine pipe size
    1. Allowable pressure loss
    2. Maximum consumption
    3. Length of pipe and fittings
    4. Specific gravity of the gas
    5. Diversity factor
b. Types of pipe material
    1. Black iron
    2. Galvinized
    3. Copper
    4. Aluminum
c. Installation methods

Provide Demonstration On:

a. Threading pipe
b. Rise in horizontal runs
c. Using pipe dope
d. Drip leg
e. Proper fittings

Provide Practical Application On:

a. Sizing a gas piping system
b. Properly installing a gas piping system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Cooper
b. Carrier Heating Manual

A/Vs:

a. Georgia, slide/tape HE-07, "Gas Piping Principles"
b. Carrier

Student Manuals:

Georgia, Heating, Unit HE-07

Tools and Equipment:

a. Gas piping and fitting
b. Pipe cutter and threading tools
c. Pipe wrenches
d. Small hand tools

CLASSROOM HOURS 18

EVALUATION (HE-07)

a. Given the BTU input of gas heating systems, the student will calculate size and properly install gas house piping.

b. Georgia, Electro-Mechancial, Instructor Guide, Vol. IV, 1980.

TASK

HE-08 Installing and adjusting gas regulators

PERFORMANCE OBJECTIVE

Install and adjust gas pressure regulators.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Identifying component parts of a pressure regulator
b. Function of each component
c. Purpose of regulators
d. Installation procedures
e. Sizing a regulator

Provide Demonstration On:

a. Removing, disassembling and repairing a regulator
b. Installing and adjusting a pressure regulator

Provide Practical Application On:

a. Disassembling and reassembling a gas pressure regulator
b. Sizing a regulator

INSTRUCTIONAL MATERIALS

Textbooks:

a. Cooper
b. Carrier Heating Manual

A/Vs:

a. Georgia, slide/tape HE-08, "Adjusting Regulators"
b. Carrier

Student Manuals:

Georgia, Heating, Unit HE-08

Tools and Equipment:

a. Pipe wrenches
b. Water manometer
c. Small hand tools
d. Regulators
e. Gas heating system

CLASSROOM HOURS

6

EVALUATION (HE-08)

a. Given a gas pressure regulator and water manometer, the student will properly install and adjust the gas pressure regulator.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

HE-09 Installing and servicing gas valves

PERFORMANCE OBJECTIVE

Install and service gas valves on gas heating systems and troubleshoot gas valve problems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Solenoid valve
b. Diaphragm valve
c. Bimetal valve
d. Heat motor valve
e. Function of valves
f. Installation procedures
g. Diagnosing problems
h. Servicing procedures
i. Testing for leaks

Provide Demonstration On:

a. An operating gas valve
b. Installation procedures

Provide Practical Application On:

Removing, disassembling, reassembling, reinstalling and testing a gas valve

INSTRUCTIONAL MATERIALS

Textbooks:

a. Cooper
b. Carrier Heating Manual

A/Vs:

a. Georgia, slide/tape HE-09, "Installing and Servicing Gas Valves"
b. Carrier

Student Manuals:

Georgia, Heating, Unit HE-09

Tools and Equipment:

a. Pipe wrenches
b. Small hand tools
c. Volt-ohmmeter
d. Soap bubbles
e. Water manometer
f. Various types of gas valves
g. Gas heating system

CLASSROOM HOURS 6

EVALUATION (HE-09)

a. Given the proper tools and equipment, the student will remove, repair, replace and properly troubleshoot a gas valve on a gas heating system.

b. Georgia, Electro-Mechancial, Instructor Guide, Vol. IV, 1980.

TASK

HE-10 Installing and servicing pilot ignition devices

PERFORMANCE OBJECTIVE

Install and service pilot ignition devices on gas heating systems and troubleshoot pilot ignition problems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Components of a pilot ignition system and their function
b. Pilot burner
c. Direct spark ignition
d. Glow coil
e. Spark ignition of a pilot
f. Diagnosing problems
g. Hazards with pilot systems
h. Installation procedures for a pilot ignition system

Provide Demonstration On:

a. Installing a pilot ignition
b. Proper and improper pilot ignition operation

Provide Practical Application On:

Installing a pilot ignition system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse
b. Cooper
c. Carrier Heating Manual

A/Vs:

a. Georgia, slide/tapes HE-10a and HE-10b, "Installing and Servicing Pilot Ignition Devices"
b. Carrier

Student Manuals:

Georgia, Heating, Unit HE-10

Tools and Equipment:

a. Small hand tools
b. Soap bubbles
c. Millivolt tester
d. Pilot ignition system
e. Gas heating system

CLASSROOM HOURS 12

EVALUATION (HE-10)

Given an operational gas furnace, the student will properly remove and replace a pilot ignition system so that the furnace is fully operational.

TASK

HE-11 Installing and servicing combination gas valves

PERFORMANCE OBJECTIVE

Diagnosing malfunctions and replacing combination gas valves.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Components of combination gas valves and their functions
b. Diagnosing malfunctions
c. Installing a combination gas valve
d. Testing a combination gas valve
    1. Leaks
    2. Safety drop time
    3. Manifold pressure
    4. Control circuit amp draw

Provide Demonstration On:

Installation of a combination gas valve

Provide Practical Application On:

a. Diagnosing problems in a combination gas valve
b. Replacing combination gas valves

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse
b. Cooper
c. Carrier Heating Manual

A/Vs:

a. Georgia, slide/tapes HE-11a and HE-11b, "Installing and Servicing Combination Gas Valves"
b. Carrier

Student Manuals:

Georgia, Heating, Unit HE-11

Tools and Equipment:

a. Pipe wrenches
b. Small hand tools
c. Millivolt meter
d. Volt-ohmmeter
e. Water manometer
f. Combination gas valve
g. Gas heating system

CLASSROOM HOURS 6

EVALUATION (HE-11)

a. Given a combination gas valve, proper tools and equipment, the student will install the valve on an operational gas furnace, check for leaks, set to proper pressure and troubleshoot gas valve problems.

b. Georgia, Electro-Mechancial, Instructor Guide, Vol. IV, 1980.

TASK

HE-12 Servicing gas burners

PERFORMANCE OBJECTIVE

Remove and service burners on a gas furnace.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of burners
b. Recognizing proper and improper flames
c. Procedure for removing a burner
d. Diagnosing burner malfunctions
e. Installing burners
f. Types of burners
g. Burner adjustment

Provide Demonstration On:

a. Different types of burners
b. Removing and installing burners
c. Adjusting the burner flame

Provide Practical Application On:

a. Installing a gas burner
b. Adjusting and testing burners
c. Diagnosing malfunctions and making repairs

INSTRUCTIONAL MATERIALS

Textbooks:

a. Cooper
b. Carrier Heating Manual

A/Vs:

a. Georgia, slide/tape, HE-12 "Servicing Gas Burners"
b. Carrier

Student Manuals:

Georgia, Heating, Unit HE-12

Tools and Equipment:

a. Small hand tools
b. Flash light
c. Pipe wrench
d. Wire brush
e. Orifice drill set
f. Burner
g. Operational gas furnace

CLASSROOM HOURS

12

EVALUATION (HE-12)

a. Given an operational gas furnace, the student will properly remove, service and replace a burner assembly to operate properly when completed.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

HE-13 Inspecting and adjusting temperature rise of heat exchangers

PERFORMANCE OBJECTIVE

Determine and adjust temperature rise of heat exchangers in gas heating systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of heat exchangers
b. Effect of gas pressure and CFM of air on temperature rise
c. Determining temperature rise
d. Diagnosing problems in heat exchangers
e. Causes of improper temperature rise
f. Correcting problems in heat exchangers
g. Hazzards of defective heat exchangers

Provide Demonstration On:

Inspecting temperature rise in an operating furnace

Provide Practical Application On:

a. Diagnosing various malfunctions in a heat exchanger
b. Adjusting furnace for proper temperature rise

INSTRUCTIONAL MATERIALS

Textbooks:

a. Cooper
b. Carrier Heating Manual

A/Vs:

a. Georgia, slide/tape HE-13, "Inspecting and Determining Temperature Rise of Heat Exchangers"
b. Carrier

Student Manuals:

Georgia, Heating, Unit HE-13

Tools and Equipment:

a. Thermometers
b. Small hand tools
c. Water manometers
d. Operational gas furnace
e. Heat exchangers

CLASSROOM HOURS 6

EVALUATION (HE-13)

a. Given an operational gas furnace, the student will inspect the heat exchanger for defects, adjust primary air and gas pressure and insure proper temperature rise.

b. Georgia, Electro-Mechancial, Instructor Guide, Vol. IV, 1980.

TASK

HE-14 Venting gas heating systems

PERFORMANCE OBJECTIVE

Calculate size and install vents for gas heating systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Function of a venting system
b. Hazards of improper venting
c. Diagnosing improper venting
d. Combustion grills and method of rating grill size
e. Determining cubic feet of combustion air and free area of grills
f. Individual venting
g. Determining vent size
h. Venting for primary and secondary air
i. Installing a venting system

Provide Demonstration On:

Proper venting procedures

Provide Practical Application On:

a. Selecting material for vents
b. Determining vent size for various conditions
c. Installing a venting system on a warm air furnace
d. Testing a venting system on a warm air furnace

INSTRUCTIONAL MATERIALS

Textbooks:

a. Prentice-Hall, Refrigeration and Air Conditioning
b. Carrier Heating Manual

A/Vs:

Carrier

Student Manuals:

Georgia, Heating, Unit HE-14

Tools and Equipment:

a. Small hand tools
b. Wooden matches
c. Steel tape measure
d. Sheet metal screws
e. Operational gas furnace
f. Vent pipe and venting materials

CLASSROOM HOURS	12

EVALUATION (HE-14)

a. Given an operational gas furnace, the student will calculate size and properly install the vent on a gas furnace.

b. Georgia, Electro-Mechancial, Instructor Guide, Vol. IV, 1980.

TASK

HE-15 Servicing gas furnace electrical controls

PERFORMANCE OBJECTIVE

Diagnose and service the electrical controls of a gas furnace.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Thermostat
b. Fan relay
c. Fan limit
d. Fan switch
e. Two speed fan motors
f. Low voltage transformer
g. Wiring, line and low voltage
h. Function of each component
i. Diagnosing problems

Provide Demonstration On:

Electrical controls of operational furnace

Provide Practical Application On:

a. Wiring electrical components of a gas heating system
b. Diagnosing and repairing various malfunctions

INSTRUCTIONAL MATERIALS

Textbooks:

a. Cooper
b. Carrier Heating Manual

A/Vs:

a. Georgia, slide/tape, HE-15, "Servicing Electrical Controls"
b. Carrier

Student Manuals:

Georgia, Heating, Unit HE-15

Tools and Equipment:

a. Small hand tools
b. Volt-ohmmeter
c. Millivolt meter
d. Amprobe
e. Functional gas furnace

CLASSROOM HOURS

12

EVALUATION (HE-15)

a. Given an operational gas furnace, the student will diagnose and service all the electrical controls.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

HE-16 Determining combustion efficiency

PERFORMANCE OBJECTIVE

Determine the combustion efficiency in a gas heating system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Using a test kit
b. Proper combustion
c. Testing for proper combustion
d. Making adjustments to achieve proper combustion

Provide Demonstration On:

a. Use of a combustion test kit
b. Testing the combustion efficiency on a operating furnace

Provide Practical Application On:

a. Testing an operating furnace for proper combustion using a test kit
b. Making various adjustments to produce the highest efficency in the system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Cooper
b. Carrier Heating Manual

A/Vs:

a. Georgia, slide/tape HE-16, "Determining Combustion Efficiency"
b. Carrier

Student Manuals:

Georgia, Heating, Unit HE-16

Tools and Equipment:

a. Combustion test kit with operating instructions
b. Small hand tools
c. Operational gas furnace

CLASSROOM HOURS 9

EVALUATION (HE-16)

a. Given an operational gas furnace and combustion efficiency test kit, the student will determine the combustion efficiency and adjust the furnace for maximum combustion efficiency.

b. Georgia, Electro-Mechancial, Instructor Guide, Vol. IV, 1980.

TASK

HE-17 Performing a pre-season check-up and start-up on a gas furnace

PERFORMANCE OBJECTIVE

Perform a pre-season check-up and start-up on a gas heating system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Venting
b. Air filters
c. Blower belt
d. Blower motor and blade
e. Fan switch
f. Gas leaks
g. Pressure regulator
h. Pilot and thermocouple
i. Limit switch
j. Heat exchanger
k. Thermostat
l. Combustion efficiency
m. Wiring
n. Checking complete cycle
o. Proper use of check sheet

Provide Demonstration On:

Performing a complete pre-season check-up on a gas furnace

Provide Practical Application On:

Performing a pre-season check on an operating furnace using a check sheet

INSTRUCTIONAL MATERIALS

Textbooks:

a. Althouse
b. Cooper
c. Manufacturer's instruction and maintenance manual

A/Vs:

Georgia, slide/tape HE-17, "Performing Pre-Season Check-Up and Start-Up"

Student Manuals:

Georgia, Heating, Unit HE-17

Tools and Equipment:

a. Small hand tools
b. Volt-ohmmeter
c. Flashlight
d. Oil can and grease
e. Thermometers
f. Mirror
g. Operational gas furnace

CLASSROOM HOURS 6

EVALUATION (HE-17)

a. Given an operational gas furnace, the student will perform a pre-season check and start-up.

b. Georgia, Electro-Mechancial, Instructor Guide, Vol. IV, 1980.

TASK

HE-18 Troubleshooting the gas heating system

PERFORMANCE OBJECTIVE

Locate, diagnose and repair combustion and electrical problems in gas furnaces.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Filters
b. Pilot problems
c. Main gas valve problems
d. Thermostat calibration
e. Gas pressure
f. Heat exchanger
g. Venting systems
h. Proper combustion
i. Burners
j. Fan system

Provide Demonstration On:

Correct troubleshooting techniques

Provide Practical Application On:

Diagnosing and repairing various malfunctions in a gas furnace

INSTRUCTIONAL MATERIALS

Textbooks:

a. Cooper
b. Carrier Heating Manual

Student Manuals:

Georgia, Heating, Unit HE-18

Tools and Equipment:

a. Combustion test kit
b. Small hand tools
c. Flashlight
d. Volt-ohmmeter
e. Water manometer
f. Operational gas furnace

CLASSROOM HOURS 12

EVALUATION (HE-18)

a. Given a warm air gas furnace with electrical, mechanical and combustion problems, the student will properly locate the problems and make necessary repairs.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

HE-19 Identifying types of fuel oil and principles of combustion

PERFORMANCE OBJECTIVE

Identify different grades of fuel oil and their principle uses.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

Different grades of oil
1. Where they are used
2. How they are used
3. BTU content
4. Viscosity
5. Pour point
6. Flash point
7. Fire point

Provide Demonstration On:

Grades of fuel oil

Provide Practical Application On:

Identifying different grades of fuel oil by their characteristics

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burkhardt
b. Carrier, Oil Burners

Student Manuals:

Georgia, Heating, Unit HE-19

Tools and Equipment:

Various grades of fuel oil

CLASSROOM HOURS 6

EVALUATION (HE-19)

a. Given samples of different grades of fuel oil, the student will identify and define the use and heat value of each.

b. Georgia, Electro-Mechancial, Instructor Guide, Vol. IV, 1980.

TASK

HE-20 Designing and installing oil piping

PERFORMANCE OBJECTIVE

Design and install oil piping and oil tanks for an oil heated system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Installing an outside oil tank
b. Local and state codes for outside oil tanks and piping
c. Accessory piping
d. Oil filter types
e. Two-pipe oil burning system
f. Single-pipe oil burning system

Provide Demonstration On:

Properly designed oil burner pipe and tank systems

Provide Practical Application On:

Designing and installing an oil storage tank and piping system for an oil burning furnace

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burkhardt
b. Georgia State Code

Student Manuals:

Georgia, Heating, Unit HE-20

Tools and Equipment:

a. Small hand tools
b. Tube cutting and flaring set
c. Fittings
d. Oil storage tank

CLASSROOM HOURS 12

EVALUATION (HE-20)

a. Given an oil burning furnace, the student will design the piping and oil storage tank.

b. Georgia, Electro-Mechancial, Instructor Guide, Vol. IV, 1980.

TASK

HE-21 Installing oil burners

PERFORMANCE OBJECTIVE

Install a low pressure burner on a domestic oil furnace.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The burner assembly
    1. Pump
    2. Blower
    3. Electrode assembly
    4. Nozzle
    5. Transformer
    6. Coupling
    7. Electric motor

b. Installing an oil burner assembly

Provide Demonstration On:

a. Removing and replacing a burner on a domestic oil burner

b. Identifying each component of burner assembly

Provide Practical Application On:

Removing and installing a burner assembly on a domestic oil furnace

INSTRUCTIONAL MATERIALS

Textbooks:

Burkhardt

A/Vs:

Georgia, slide/tape HE-21a, "Installing Oil Burners"

Student Manuals:

Georgia, *Heating*, Unit HE-21

Tools and Equipment:

a. Small hand tools

b. Socket set with extension

c. Burner assembly

CLASSROOM HOURS

12

EVALUATION (HE-21)

a. Given an oil fired furnace and gun assembly, the student will properly install the assembly and place the unit in operation.

b. Georgia, Electro-Mechancial, Instructor Guide, Vol. IV, 1980.

TASK

HE-22 Installing and servicing transformers and electrodes

PERFORMANCE OBJECTIVE

Install and service transformer, electrodes, high tension leads and insulators on oil burning furnaces.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Step-up transformer
b. Testing the transformer
c. Electrodes
  1. Settings of electrodes
  2. Testing of electrodes
d. High tension leads
e. Insulators

Provide Information On:

Correct installation and servicing techniques for the fuel oil ignition system

Provide Practical Application On:

a. Identifying the components of the ignition system
b. Removing and re-installing the ignition assembly
c. Troubleshooting problems in the ignition system

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burkhardt
b. Field

A/Vs:

Georgia, slide/tape HE-22a, "Installing and Servicing Transformers and Electrodes"

Student Manuals:

Georgia, Heating, Unit HE-22

Tools and Equipment:

a. Small hand tools
b. Volt-ohmmeter
c. Socket set
d. Operational oil burner

CLASSROOM HOURS 6

EVALUATION (HE-22)

a. Given an oil burning furnace, the student will remove, replace and troubleshoot problems in the ignition assembly.

b. Georgia, Electro-Mechancial, Instructor Guide, Vol. IV, 1980.

TASK

HE-23 Installing oil pumps

PERFORMANCE OBJECTIVE

Remove, repair, service and replace an oil pump assembly on a fuel oil furnace.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The pump assembly
b. Single stage pumps
c. Two stage pumps
d. Identifying component parts of the pump
e. Venting air from the pump
f. Advantages of using two stage pumps with underground tanks
g. Diagnosing pump malfunctions

Provide Demonstration On:

Correct procedures for removing, servicing or repairing and replacing the pump assembly

Provide Practical Application On:

a. Diagnosing and repairing or replacing an oil burner pump
b. Adjusting oil pressure

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burkhardt
b. Althouse

A/Vs:

Georgia, slide/tape HE-23, "Installing Oil Pumps"

Student Manuals:

Georgia, Heating, Unit HE-23

Tools and Equipment:

a. Small hand tools
b. Pressure gauge
c. Operational oil furnace
d. Oil pump assembly

CLASSROOM HOURS 6

EVALUATION (HE-23)

a. Given an oil burning furnace, the student will properly remove, repair, replace and test an oil pump assembly.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

HE-24 Servicing blower, nozzle, motor and coupling

PERFORMANCE OBJECTIVE

Install, troubleshoot and service combustion blower, nozzle, motor and coupling on an oil burning heating system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of motors
b. Reset button
    1. Manual-reset
    2. Automatic-reset
c. Checking the motor
    1. Required voltage (EMF) supply
    2. Hertz (cycle)
    3. Running current (amperes)
    4. Locked current draw
    5. Temperature rise
d. Types of couplings and their functions
e. Blowers and their functions
b. Nozzles and their functions
g. Diagnosing malfunctions in motors, blowers, couplings and nozzles

Provide Demonstration On:

Proper troubleshooting, repair and servicing procedures

Provide Practical Application On:

Troubleshooting, repairing and servicing procedures

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burkhardt
b. Field
c. Cooper

Student Manuals:

Georgia, Heating, Unit HE-24

Tools and Equipment:

a. Small hand tools
b. Socket set
c. Volt-ohmmeter
d. Flashlight
e. Operational oil burning heating system

CLASSROOM HOURS 6

EVALUATION (HE-24)

a. Given an oil burning furnace, the student will properly install, troubleshoot and service the combustion blower, nozzle, motor and coupling so that the unit is fully operational.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

HE-25 Performing the combustion efficiency test

PERFORMANCE OBJECTIVE

Determine the types of heat exchangers, vent systems and perform a combustion efficiency test on oil burning systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Type and shape of combustion chamber
b. Different types of heat exchangers
c. Types of vent pipe
d. Restrictions on the use of different types of vent pipe
e. Barometric dampers
f. Performing the combustion efficiency test
g. CO_2 analysis
h. Stack temperature
i. Smoke test
j. Draft test

Provide Demonstration On:

a. Performing the combustion efficiency test
b. Type A, B and C vent systems

Provide Practical Application On:

a. Performing a combustion efficiency analysis
b. Installing vent pipe
c. Diagnosing malfunctions in the combustion chamber and heat exchanger

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burkhardt
b. Georgia State Code

A/Vs:

Georgia, slide/tape HE-25, "Installing Vent and Heat Exchanger"

Student Manuals:

Georgia, Heating, Unit HE-25

Tools and Equipment:

a. CO_2 analyzer kit
b. Small hand tools
c. Flashlight
d. Operational oil burning heating system

CLASSROOM HOURS 12

EVALUATION (HE-25)

a. Given an operational oil burning furnace, the student will properly determine the type of heat exchanger vent system and perform a combustion efficiency test.

b. Georgia, Electro-Mechancial, Instructor Guide, Vol. IV, 1980.

TASK

HE-26 Installing controls

PERFORMANCE OBJECTIVE

Identify, remove and replace primary and safety controls on an oil fired heating system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Control transformer
b. Control pump and blower
c. Constant ignition switch
d. Intermittent ignition switch
e. Stack switch
f. Fan and limit control
g. Cadmium cell
h. Wiring of components
i. Diagnosing malfunctions in the system

Provide Demonstration On:

Proper techniques for troubleshooting, removing and replacing controls

Provide Practical Application On:

Diagnosing, repairing, removing and replacing controls

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burkhardt
b. Field

Student Manuals:

Georgia, Heating, Unit HE-26

Tools and Equipment:

a. Small hand tools
b. Flashlight
c. Wiring diagrams
d. Volt-ohmmeter
e. Amprobe
f. Operational oil burning heating system

CLASSROOM HOURS 13

EVALUATION (HE-26)

a. Given an operational oil burning furnace, the student will properly identify, remove and replace primary control and safety controls and insure proper operation.

b. Georgia, Electro-Mechancial, Instructor Guide, Vol. IV, 1980.

TASK

HE-27 Performing pre-season start-up and check-up on an oil burning heating system

PERFORMANCE OBJECTIVE

Perform pre-season start-up and check-up on an oil burning heating system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Nozzle check
b. Primary control operation
c. Fan motor
d. Fan and limit switches
e. Oil pump pressure
f. Combustion efficiency
g. Proper ignition
h. Electrode setting
i. Oil filter cleaning
j. Using a checklist

Provide Demonstration On:

Steps in making a pre-season check and start-up

Provide Practical Application On:

Performing tests on all parts of an oil burning furnace and making adjustments for proper operation of the furnace

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burkhardt
b. Cooper
c. Manufacturer's operating and maintenance manuals

A/Vs:

Georgia, slide/tape HE-27 "Performing Pre-Season Start-Up and Check-Ups"

Student Manuals:

Georgia, *Heating*, Unit HE-27

Tools and Equipment:

a. Small hand tools
b. Pressure gauge
c. Flashlight
d. Volt-ohmmeter
e. Amprobe
f. Combustion efficiency test kit
g. Operational oil burning furnace

CLASSROOM HOURS

6

EVALUATION (HE-27)

a. Given an operational oil burning furnace, the student will properly perform a pre-season start-up and check and will make any adjustments necessary for the proper operation of the furnace.

b. Georgia, Electro-Mechancial, Instructor Guide, Vol. IV, 1980.

TASK

HE-28 Troubleshooting the oil burning heating system

PERFORMANCE OBJECTIVE

Troubleshoot all the operational devices on an oil fired heating system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Sequence of operation of an oil burning heating system
b. The use of a checklist
c. Diagnosing various malfunctions
d. Testing combustion efficiency
e. Fuel oil problems
f. Transformer and electrode problems
g. Nozzle problems
h. Primary control problems
i. Flame detector problems
j. Fan limit switch problems

Provide Demonstration On:

The use of test instruments in diagnosing problems

Provide Practical Application On:

Diagnosing malfunctions and making necessary repairs for the proper operation of the furnace

INSTRUCTIONAL MATERIALS

Textbooks:

a. Burkhardt
b. Cooper
c. Manufacturer's manuals

A/Vs:

Georgia, slide/tape HE-28, "Troubleshooting the Oil Burning Heat System"

Student Manuals:

Georgia, Heating, Unit HE-28

Tools and Equipment:

a. Small hand tools
b. Flashlight
c. Volt-ohmmeter
d. Amprobe
e. Pressure gauge
f. Combustion test kit
g. Mirror
h. Operational oil burning furnace

CLASSROOM HOURS 12

EVALUATION (HE-28)

a. Given an oil burning furnace, the student will diagnose various malfunctions in the system and make any necessary repairs so that the furnace is fully operational.

b. Georgia, Electro-Mechanical, Instructor Guide, Vol. IV, 1980.

TASK

SM-01 Identifying materials used in sheet metalwork

PERFORMANCE OBJECTIVE

Identify the various metals, alloys, coated metals and supplies and special properties required of metals used in the air conditioning, heating and refrigeration industry.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

- a. Properties of sheet metals
  - 1. Strength
  - 2. Ductility
  - 3. Malleability
  - 4. Weldability
  - 5. Hardness
  - 6. Toughness
  - 7. Brittleness
  - 8. Cold-working
- b. Types of sheet metal
  - 1. Metals
  - 2. Alloys
  - 3. Coated metals
  - 4. Supplies

(continued on next page)

Provide Demonstration On:

- a. Identifying types of sheet metal
- b. Making property tests on various sheet metals
- c. Determining gage, weight and size of metals

Provide Practical Application On:

(continued on next page)

INSTRUCTIONAL MATERIALS

Textbooks:

- a. Johnson, Technical Metals
- b. Feirer, Metalwork

A/Vs:

Bergwall Productions, Inc., filmstrip, "Sheet Metalwork, Introduction and Overview"

Tools and Equipment:

- a. Metal samples
  - 1. Galvanized iron
  - 2. Tin plate
  - 3. Galvannealed iron
  - 4. Zinc
  - 5. Black iron sheets
  - 6. Sheet copper
  - 7. Aluminum
  - 8. Stainless steel

(continued on next page)

CLASSROOM HOURS

4

EVALUATION (SM-01)

a. Given various samples of sheet metals, the student will accurately identify each as to type of metal, alloy or coated metal.

b. Given an instructor developed test, the student will accurately relate the special properties required of metals used in the air conditioning, heating and refrigeration industry.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

c. Factors that determine the selection of various metals
    1. Specifications
    2. Availability
    3. Cost
    4. Economical sizes
d. Standard gages, weights and sizes of sheet metal

Provide Practical Application On:

a. Have student compare various sheet metals by making simple property tests and note how metals react to:
    1. Hammering
    2. Bending
    3. Weight
b. Have student visually identify metal samples on display board

INSTRUCTIONAL MATERIALS

Tools and Equipment:

b. Hammer
c. Thickness gauge calipers
d. Standard gage and weight tables
e. Rules

TASK

SM-02 Developing sheet metal patterns (stretchouts)

PERFORMANCE OBJECTIVE

Develop a straight-line, a parallel-line, a radial-line and a triangulation sheet metal pattern (stretchout).

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of patterns
    1. Straight-line or angular
    2. Parallel-line or cylindrical
    3. Triangulation or transition

b. Single hems
c. Double hems
d. Lap seams
e. Grooved seams
f. Edges (wired)
g. Master patterns or templates
h. Notching and clipping

Provide Demonstration On:

a. Developing a straight-line layout
b. Developing a parallel-line layout
c. Developing a radial-line layout
d. Developing a triangulation layout
e. Making allowances for edges, seams and hems
f. Notching and clipping sheet metal

Provide Practical Application On:

(continued on next page)

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson, Technical Metals
b. Feirer, Metalwork

A/Vs:

a. Bergwall Productions, Inc., filmstrip, "Straight Line Pattern Development"
b. Bergwall Productions, Inc., filmstrip, "Parallel and Radial Line Pattern Development"

Tools and Equipment:

a. Paper
b. Prick punch
c. Scratch awl
d. Pencil
e. Protractor
f. Straight edge
g. Sheet metal

CLASSROOM HOURS

6

EVALUATION (SM-02)

Using appropriate tools and straight, parallel, radial and triangulation developments, the student will accurately layout a pattern (stretchout) of each and accurately transfer each to sheet metal.

INSTRUCTIONAL ACTIVITIES

Provide Practical Application On:

a. Have student develop stretchouts using straight, parallel, radial and triangulation layout
b. Have student transfer pattern to sheet metal

TASK

SM-03 Cutting sheet metal

PERFORMANCE OBJECTIVE

Cut sheet metal using hand snips and shears.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Hand snips
   1. Straight snips
   2. Double cutting snips
   3. Hawk-billed snips
   4. Aviation snips
   5. Circular cutting snips
   6. Heavy duty snips
b. Cutting straight and curved lines
c. Using the hollow punch
d. Portable power shears
e. Rotary and lever slitting shears
f. Squaring shears
   1. Front gage
   2. Back gage
   3. Front and bevel-gage with pattern
g. Cold chisel

Provide Demonstration On:

a. Cutting sheet metal with hand snips
b. Using the hollow punch
c. Cutting sheet metal using portable power, rotary and lever slitting shears
d. Cutting sheet metal with squaring shears

Provide Practical Application On:

a. Have student use hand snips to cut to a pattern layout
b. Have student cut sheet metal with squaring shears

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson, Technical Metals
b. Feirer, Metalwork

A/Vs:

a. Prentice-Hall Media, filmstrip, "Cutting Sheet Metal"
b. Bergwall Productions, Inc., filmstrip, "Cutting Methods"

Tools and Equipment:

a. Squaring shears
b. Hand snips
c. Metal
d. Pattern
e. Prick punch
f. Scratch awl
g. Hollow punch
h. Ballpeen hammer
i. Cold-chisel
j. Hacksaw
k. Combination square

CLASSROOM HOURS 6

EVALUATION (SM-03)

a. Provided a pattern and metal, the student will accurately cut sheet metal to the pattern using hand snips.

b. Provided a pattern and metal, the student will accurately transfer the pattern and use squaring shears to cut the metal.

TASK

SM-04 Bending sheet metal by hand

PERFORMANCE OBJECTIVE

Bend sheet metal by hand.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Bending equipment
    1. Bench plate or stakeholder
    2. Beakhorn stake
    3. Bottom stake
    4. Coppersmith stake
    5. Common square stake
    6. Beveled-edge stake
    7. Double-seaming stake
    8. Round-head stake
    9. Hatchet stake
    10. Creasing stake
    11. Needle case stake
    12. Candlemold stake
    13. Blowhorn stake
    14. Conductor stake

(continued on next page)

Provide Demonstration On:

a. Using stakes, seamers, hammers and mallets
b. Making angular bends
c. Bending cylindrical shapes
d. Forming cone-shaped articles

Provide Practical Application On:

a. Have student make a sharp-angle bend over hatchet stake
b. Have student form a curved piece over a stake or pipe
c. Have student form a cone-shaped object such as part of a funnel

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson, Technical Metals
b. Feirer, Metalwork

A/Vs:

Bergwall Productions, Inc., filmstrip, "Forming and Bending-Part 2"

Tools and Equipment:

a. Stakes
b. C-clamps
c. Vise
d. Hardwood blocks
e. Steel bars
f. Wooden or rawhide mallet
g. Riveting hammer
h. Setting-down hammer
i. Seamers
j. Metal

CLASSROOM HOURS 6

EVALUATION (SM-04)

Using previously cut metal and appropriate bending tools, the student will, by hand, make a box to 1/32" accuracy, form a cylinder and a cone to job specifications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

15. Hollow mandrel stake
16. Double-seaming stake with four heads
17. Handy seamer
18. Riveting hammer
19. Setting-down hammer
20. Wooden or rawhide mallet

b. Angular bends
c. Bending cylindrical shapes
d. Forming cone-shaped articles

TASK

SM-05 Bending metal on a bar folder or brake

PERFORMANCE OBJECTIVE

Bend metal on a bar folder or brake.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Operation of the bar folder
b. Making a fold or hem
c. Making a rounded fold for a wired edge
d. Brakes
    1. Cornice brake
    2. Box and pan brake

Provide Demonstration On:

a. Operating the bar folder
b. Forming folds and hems on the bar folder
c. Operating brakes

Provide Practical Application On:

a. Have student use the bar folder to form a sharp fold, a rounded fold, right-angle folds, a hem and a double hem
b. Have student use a box and pan brake to form a box

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson, Technical Metals
b. Feirer, Metalwork

A/Vs:

Bergwall Productions, Inc., filmstrip, "Drilling, Forming and Bending - Part 1"

Tools and Equipment:

a. Bar folder
b. Brake
c. Setting hammer
d. Metal
e. Mallet

CLASSROOM HOURS 6

EVALUATION (SM-05)

a. Using sheets of metal and a bar folder, the student will accurately form a sharp fold, a rounded fold, right-angle folds, a hem and a double hem.

b. Using a box and pan brake, the student will accurately make a layout on the metal and form a box.

TASK

SM-06 Roll-forming sheet metal

PERFORMANCE OBJECTIVE

Roll-form sheet metal.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Operation of forming rools or slip-roll
b. Forming a cylinder
c. Rolling a cylinder with a fold on both edges
d. Rolling a cylinder with a wired edge
e. Forming cone shapes

Provide Demonstration On:

a. Operating the roll-forming machine
b. Forming a cylinder or a cylinder with a fold on both edges
c. Rolling a cylinder with a wired edge
d. Forming cone shapes

Provide Practical Application On:

a. Have student form a cylinder and a cylinder with a fold on both edges
b. Have student roll a cylinder with a wired edge
c. Have student roll-form a cone shape

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson, Technical Metals
b. Feirer, Metalwork

Tools and Equipment:

a. Metal
b. Roll-forming machine

CLASSROOM HOURS

6

EVALUATION (SM-06)

Using a roll-forming (or slip rolling) machine and sheets of metal, the student will accurately form a cylinder, a cylinder with a fold on both edges, a cylinder with wired edge and a cone.

TASK

SM-07 Making seams

PERFORMANCE OBJECTIVE

Form sheet metal seams.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Seams
   1. Single
   2. Butt
   3. Lap
      - Plain lap
      - Counter sunk or offset lap
      - Inside or outside corner lap
   4. Grooved and folded
   5. Standing
   6. Double
   7. Pittsburgh lock

b. Hand groovers

Provide Demonstration On:

a. Double-seaming a bottom on a cylinder
b. Double-seaming a square or rectangular article
c. Making a folded or grooved seam

Provide Practical Application On:

a. Have student form single, butt, lap, standing and double seams
b. Have student form a folded or grooved seam

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson, Technical Metals
b. Feirer, Metalwork

A/Vs:

a. Prentice-Hall Media, filmstrip, "Seams and Joints"
b. Bergwall Productions, Inc., filmstrip, "Assembly and Fastening"

Tools and Equipment:

a. Bar folder or brake
b. Burring machine
c. Hand groover
d. Setting hammer
e. Mallet
f. Stakes
g. Metal

CLASSROOM HOURS 6

EVALUATION (SM-07)

a. Given a burring or flanging machine, setting hammer and a cylinder, the student will accurately form single seams to fasten a bottom to the cylinder.

b. Given a bar folder, mallet, setting hammer and metal, the student will accurately form a double seam on a square container.

c. Given a bar folder, metal, a hand groover and mallet, the student will accurately form a folded or grooved seam.

TASK

SM-08 Using the rotary machine

PERFORMANCE OBJECTIVE

Use the rotary machine to wire an edge, turn a burr, bead and crimp sheet metal.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. The combination rotary machine
b. Making a wired edge
c. Turning an edge
d. Closing the wired edge by hand
e. Closing the wired edge by machine
f. Turning a burr or flange
g. Beading
    1. The single bead
    2. The ogee bead
    3. The triple bead
h. Crimping
i. Slitting and trimming

Provide Demonstration On:

a. Using the rotary machine
b. Wiring an edge
c. Turning a burr
d. Beading
e. Crimping

Provide Practical Application On:

a. Have student wire an edge
b. Have student bead, crimp, slit and trim metal

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson, Technical Metals
b. Feirer, Metalwork

Tools and Equipment:

a. Combination rotary machine
b. Mild steel wire
c. Stakes
d. Pliers
e. Mallet
f. Setting hammer
g. Metal

CLASSROOM HOURS 6

EVALUATION (SM-08)

a. Using the combination rotary machine, hand tools and wire, the student will select the appropriate tools and accurately wire the edge of a cylinder.

b. Given a cylindrical container, the student will select the appropriate rolls to be placed on the combination rotary machine and accurately form a single bead, an ogee bead and a triple bead.

c. Given a cylindrical object (such as a heating pipe), the student will select the appropriate rolls to be placed on the combination rotary machine and accurately crimp the edge of one end of the pipe.

TASK

SM-09 Fastening sheet metal

PERFORMANCE OBJECTIVE

Fasten sheet metal with rivets or sheet metal screws.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Riveting tools and rivets
  1. Riveting hammer
  2. Solid punch
  3. Rivet set
  4. Tinner's rivets
    - Black-iron
    - Galvanized
    - Copper
  5. Blind or pop rivets
  6. Hand lever
b. Riveting sheet metal
  1. Determining rivet length
  2. Determining rivet diameter
  3. Spacing rivets

(continued on next page)

Provide Demonstration On:

a. Using riveting tools and rivets
b. Riveting sheet metal
c. Fastening sheet metal with tapping screws

Provide Practical Application On:

a. Have student rivet sheet metal
b. Have student fasten sheet metal with tapping screws

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson, Technical Metals
b. Feirer, Metalwork

A/Vs:

a. Bergwall Productions, Inc., filmstrip, "Assembly and Fastening"
b. Prentice-Hall Media, filmstrip, "Riveting and Fastening"
c. Prentice-Hall Media, filmstrip, "Making Holes in Sheet Metal"

Tools and Equipment:

a. Rivet set
b. Solid punch
c. Riveting hammer
d. Hand lever
e. End-grain wood or lead block
f. Metal
g. Prick punch
h. Drills
i. Screws
j. Screwdriver

CLASSROOM HOURS 6

EVALUATION (SM-09)

a. Given riveting tools, rivets and a seam to be fastened, the student will accurately select the appropriate tools and set the necessary rivets.

b. Given two pieces of metal to secure together, the student will accurately select the appropriate tools and fasten the metal with threaded fasteners.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

    4. Removing a rivet
c. Fastening with tapping screws
    1. Thread cutting screws
    2. Thread forming screws
d. Installing sheet metal screws

TASK

SM-10 Cutting and welding sheet metal using oxyacetylene equipment

PERFORMANCE OBJECTIVE

Cut and weld sheet metal to specifications using oxyacetylene equipment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Oxyacetylene safety
b. Using cylinders and gases
c. Using and maintaining regulators
d. Selecting and maintaining torches and tips
e. Lighting and adjusting the flame to cut and to weld
f. Procedures for cutting
g. Procedures for welding
    - Beads
    - Lap joints
    - Butt joints
    - Corner joints
    - Fillet joints
h. Use of filler rods
i. Brazing

Provide Demonstration On:

a. Correct use of gauges, cylinders, torches and tips
b. Proper cutting technique
c. Proper welding technique

Provide Practical Application:

a. Cutting sheet metal with a torch
b. Welding sheet metal with oxyacetylene equipment

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Griffin, Basic Oxyacetylene
d. Althouse, Modern Welding
e. Oregon

A/Vs:

Georgia, Welding, Phase A, slide/tapes

Student Manuals:

Georgia, Welding, Phase A

Tools and Equipment:

a. Oxyacetylene welding and cutting equipment
b. Safety equipment
c. Sheet metal, various gages
d. Filler rods

CLASSROOM HOURS

52

EVALUATION (SM-10)

a. Given oxyacetylene welding and cutting equipment, sheet metal and other proper tools, the student will cut and weld the sheet metal to job specifications using proper and safe procedures.

b. Georgia, Welding, Instructor Guide, Vol. II, 1980.

TASK

SM-11 Welding sheet metal using metal arc welding equipment

PERFORMANCE OBJECTIVE

Weld sheet metal to specifications using shielded metal arc welding equipment.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Metal arc welding safety
b. Setting up shielded metal arc equipment to weld sheet metal
c. Selecting electrodes
d. Proper welding technique
  - Beads
  - Lap joints
  - Butt joints
  - Corner joints
  - Fillet joints

Provide Demonstration On:

a. Safety procedures
b. Proper welding technique

Provide Practical Application On:

Welding sheet metal to job specifications

INSTRUCTIONAL MATERIALS

Textbooks:

a. Georgia, Welding, Instructor Guide
b. Giachino and Weeks
c. Griffin, Basic Arc Welding
d. Oregon
e. Althouse, Modern Welding

A/Vs:

Georgia, Welding, Phase B, slide/tapes

Student Manuals:

Georgia, Welding, Phase B

Tools and Equipment:

a. Shielding metal arc welding equipment
b. Safety equipment
c. Sheet metal, various gages
d. Electrodes

CLASSROOM HOURS 40

EVALUATION (SM-11)

a. Given shielded metal arc welding equipment, sheet metal and other proper tools, the student will weld the sheet metal to job specifications using proper and safe procedures.

b. Georgia, Welding, Instructor Guide, Vol. II, 1980.

TASK

SM-12 Soft soldering sheet metal

PERFORMANCE OBJECTIVE

Soft solder sheet metal.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Soldering
b. Soldering devices
    1. Soldering coppers
    2. Soldering furnace or blowtorch
    3. Electric soldering iron
    4. Soldering gun
    5. Oxyacetylene torch
    6. Bottled-gas soldering torch
c. Solders (soft)
    1. Bar
    2. Solid wire
    3. Acid or resin-core wire
    4. Soldering paste

(Continued on back)

Provide Demonstration On:

a. Using soldering devices
b. Tinning a soldering copper
c. Soldering a seam or joint
d. Resistance soldering
e. Sweat soldering

Provide Practical Application On:

a. Have student solder a right-angle joint
b. Have student solder an appendage
c. Have student tin a soldering copper

INSTRUCTIONAL MATERIALS

Textbooks:

a. Johnson, Technical Metals
b. Feirer, Metalwork

A/Vs:

a. Prentice-Hall Media, filmstrip/cassette "Soldering"
b. Bergwall Productions, Inc., filmstrip/cassette "Assembly and Fastening"

Student Manuals:

Georgia, Welding, Phase A, Unit A-20

Tools and Equipment:

a. Soldering coppers
b. Solders
c. Fluxes
d. Bottled-gas torch
e. Electric soldering iron
f. Sal ammoniac
g. Cleaning fluid

(Continued on back)

CLASSROOM HOURS

18

EVALUATION (SM-12)

a. Given two pieces of metal, cleaning materials, flux, a soldering copper, and solder, the student will accurately solder a seam.

b. Given 3 pieces of metal, flux, solder, soldering copper and bottled-gas torch, the student will accurately sweat solder the metal.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

d. Fluxes
    1. Corrosive
    2. Non-corrosive
e. Tinning a soldering copper
f. Cleaning sheet metal before soldering
g. Soldering a seam or joint
h. Sweat soldering
i. Resistance soldering
    1. Power unit
    2. Hand piece
    3. Electrodes

INSTRUCTIONAL MATERIALS

Tools and Equipment:

h. Wire brush
i. File
j. Abrasive cloth
k. Steel wool

TASK

SE-01 Demonstrating knowledge of the basic principles of solar energy and solar radiation

PERFORMANCE OBJECTIVE

Demonstrate knowledge of the basics of solar energy and solar radiation and calculate the ideal tilt angle for a collector.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Solar vs. conventional energy
b. Basic solar energy terms
c. Solar time and clock time
d. Determining solar time
e. Factors affecting insolation
f. Determining correct tilt angle
g. Siting solar collectors
h. Measuring optimal tilt angles
i. Converting units of measurement

Provide Demonstrations On:

a. Maps of solar time and clock time
b. Calculating solar time

Provide Practical Application On:

a. Calculating solar time.
b. Calculating correct tilt angle for a given latitude and application.
c. Converting units of measurement

INSTRUCTIONAL MATERIALS

Textbooks:

Fundamentals of Solar Heating

A/Vs:

Georgia, slide set SA-1-1, and SA-1-2

Student Manuals:

Georgia, Solar Heating Systems

Tools and Equipment:

a. Flat surface
b. Cylindrical rod
c. Protractor

CLASSROOM HOURS

18

EVALUATION (SE-01)

a. Given a specific geographic location, calculate the clock time of the solar noon.

b. Given a specific geographic location, calculate the correct solar collector tilt angle for (1) solar heating only, (2) solar cooling only, and (3) solar hot water.

c. Georgia, Solar Heating Systems, Unit SA-1.

TASK

SE-02 Identifying basic solar system components and their functions

PERFORMANCE OBJECTIVE

Identify and describe the components and their functions for active and passive systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Basic principles of solar systems
b. Active and passive systems
c. Air systems
d. Water systems
e. Solar system analysis
f. Solar cooling
g. Economics

Provide Demonstration On:

a. The six components of active systems
b. Types of storage systems

Provide Practical Application On:

a. Identifying and inspecting solar system components.
b. Diagraming the components of a solar space heating system.

INSTRUCTIONAL MATERIALS

Textbooks:

Fundamentals of Solar Heating

A/Vs:

Georgia, slide set SA-2-1

Student Manuals:

Georgia, Solar Heating Systems

Tools and Equipment:

Solar system components

CLASSROOM HOURS

24

EVALUATION (SE-02)

a. Given various solar system components, correctly identify and describe the function of each component.

b. Georgia, Solar Heating Systems, Unit SA-2.

TASK

SE-03 Conducting an energy audit of a residence

PERFORMANCE OBJECTIVE

Conduct an energy audit of a residence and design changes to increase energy efficiency.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Air infiltration
b. Checking for tight construction
c. The Arkansas Plan
d. Caulking and weatherstripping
    1. Types
    2. Characteristics
    3. Advantages/problems
    4. Costs
e. Insulation
    1. Benefits
    2. Materials
    3. Applications
f. Windows and doors

Provide Demonstration On:

a. Proper use of caulking and weatherstripping
b. Types of insulating materials

Provide Practical Application On:

a. Investigating local use of the Arkansas Plan
b. Conducting an energy audit of a residence

INSTRUCTIONAL MATERIALS

Textbooks:

Georgia Tech., Craftsman's Guide

Student Manuals:

Georgia, Solar Heating Systems

Tools and Equipment:

a. Caulking and weatherstripping materials
b. Insulating materials

CLASSROOM HOURS 9

EVALUATION (SE-03)

a. Given a residential floor plan or an actual building, conduct an audit of the energy efficiency of the design and recommend changes to increase energy efficiency.

b. Georgia, Solar Heating Systems, Unit SB-1.

TASK

SE-04 Selecting passive solar approaches for new construction

PERFORMANCE OBJECTIVE

Select a design for passive solar heating/cooling capability for a new construction.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Passive solar design
   1. Direct gain
   2. Indirect gain
   3. Isolated gain
b. Hybrid designs
c. Active designs
d. Storage devices
e. Collectors
f. Absorptance for common building materials
g. Heat capacities of common materials

Provide Demonstration On:

Examples of active, passive and hybrid designs

Provide Practical Application On:

Designing a solar heating/cooling system for an existing dwelling.

INSTRUCTIONAL MATERIALS

Textbooks:

AIA, *A Survey of Passive Solar Buildings*

A/Vs:

Georgia, slide set SB-2-1, SB-2-2, SB-2-3, SB-2-4, SB-2-5

Student Manuals:

Georgia, *Solar Heating Systems*

CLASSROOM HOURS

9

EVALUATION (SE-04)

a. Given a residence house plan, design a solar heating/ cooling system that improves current efficiency; diagram expected heat flow patterns for winter day, winter night, summer day and summer night.

b. Georgia, Solar Heating Systems, Unit SB-2.

TASK

SE-05 Selecting solar collectors

PERFORMANCE OBJECTIVE

Identify types and characteristics of solar collectors and select the correct collector for particular applications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Collector components
b. Air vs. liquid collectors
c. Analyzing collector performance
d. Open vs. closed collector loops
e. Sizing collector units
f. Corrosion: Galvanic series of metals and alloys
g. Corrosion inhibitors
h. Freeze protection

Provide Demonstration On:

Types of collectors

Provide Practical Application On:

a. Analyze performance of collectors with black and non-black absorber plates.
b. Calculating storage capacity.

INSTRUCTIONAL MATERIALS

Textbooks:

Fundamentals of Solar Heating

A/Vs:

Georgia, slide set SB-3-1 and SB-3-2

Student Manuals:

Georgia, Solar Heating Systems

Tools and Equipment:

a. Two real or model liquid solar collectors, one with black absorber plate, one with non-black absorber plate, each with one or two transparent covers
b. Thermometers

CLASSROOM HOURS 6

EVALUATION (SE-05)

a. Given specifications for required capacity, ambient temperature ranges and construction requirements, select the optimal solar collector type and components.

b. Georgia, Solar Heating Systems, Unit SB-3.

TASK

SE-06 Selecting and siting thermal storage units

PERFORMANCE OBJECTIVE

Select and site the correct type and size thermal storage unit for specific applications.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Concepts of heat storage sizing
b. Calculating heat absorption
c. Sizing storage units
d. Calculating storage size
e. Locating storage units
f. Characteristics of water and pebble storage units
g. Characteristics of construction materials
h. Principles of water tank operation

Provide Demonstration On:

Types of thermal storage units

Provide Practical Application On:

a. Calculating heat absorption of a storage unit
b. Building simple storage units

INSTRUCTIONAL MATERIALS

Textbooks:

Fundamentals of Solar Heating

Student Manuals:

Georgia, Solar Heating Systems

Tools and Equipment:

Different types of thermal storage units

CLASSROOM HOURS

9

EVALUATION (SE-06)

a. Given storage capacity requirements, select a thermal storage system for a new residence construction to maximize efficiency.

b. Georgia, Solar Heating Systems, Unit SB-4.

TASK

SE-07 Selecting control devices

PERFORMANCE OBJECTIVE

Select appropriate control devices for solar heating/cooling systems.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Air system blowers
b. Heat exchangers
c. Pumps
d. Control functions
e. Hydronic specialty devices
    1. Expansion tank
    2. Air vent
    3. Check valve
    4. Vacuum breaker
    5. Pressure relief valve
    6. Balancing valve
    7. Pressure reducing valve
    8. Air elimination
    9. Dielectric union

Provide Demonstration On:

Various solar system control devices

Provide Practical Application On:

Identify the function and application of various solar system control devices.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Fundamentals of Solar Heating
b. Lennox Solar Manual

Student Manuals:

Georgia, Solar Heating Systems

CLASSROOM HOURS

9

EVALUATION (SE-07)

a. Given a solar heating/cooling system specifications, select the appropriate control devices for the system.

b. Georgia, Solar Heating Systems, Unit SB-5.

TASK

SE-08 Identifying and describing modes of solar system operation

PERFORMANCE OBJECTIVE

Identify operating modes of liquid and air systems, conditions appropriate for each operating mode, and diagram and describe proper system operation for each operating mode.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Liquid system operation
b. System components
c. Mode of operation
d. Auxiliary units
e. Temperature sensors
f. Diverting valves
g. Thermostat stages
h. Storage loop
i. Collector loop
j. Load loop
k. Duct system

Provide Demonstration On:

Schematic diagrams of liquid solar systems

Provide Practical Application On:

Labeling schematic solar system diagram of various operating modes

INSTRUCTIONAL MATERIALS

Textbooks:

a. Lennox Solar Manual
b. Fundamentals of Solar Heating

A/Vs:

Georgia, slide set SB-6-1

Student Manuals:

Georgia, Solar Heating Systems

Tools and Equipment:

Schematic diagrams of various modes of a liquid solar system

CLASSROOM HOURS

6

EVALUATION (SE-08)

a. Given various schematic diagrams of liquid solar system operating modes, the student will be able to correctly label each component and its function.

b. Georgia, Solar Heating Systems, Unit SB-6.

TASK

SE-09 Calculating heat load for space or domestic hot water heating

PERFORMANCE OBJECTIVE

Calculate rate of heat loss for buildings; daily, monthly and annual space heating loads; domestic hot water heating loads.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Calculating building heat load
b. Implications of a building heat load
c. Resistance to heat flow
d. Coefficient of heat transmission
e. Rate of heat conduction through a unit area of unit thickness
f. Table for values of R, U and 1/k for various materials, air spaces and surface air films
g. Calculating R_t, U
h. Degree days and design temperatures

(Continued on back)

Provide Demonstration On:

Calculating various problems relating to heat loss and heating loads

Provide Practical Application On:

Calculate heat loads for various size and types of buildings.

INSTRUCTIONAL MATERIALS

Textbooks:

Fundamentals of Solar Heating

Student Manuals:

Georgia, Solar Heating Systems

Tools and Equipment:

Residence house plants

CLASSROOM HOURS

9

EVALUATION (SE-09)

a. Given the house plans for a residence, calculate the building heat load, the heat load for domestic hot water heating, and the rate of heat loss.

b. Georgia, Solar Heating Systems, Unit SB-7.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

i. Using design and degree day data table
j. Calculating heat loss rate
k. Calculating heat loss rates from concrete slabs on grade
l. Calculating heat loss rates in basements
m. Duct heat loss
n. Infiltration heat loss
o. Space heat loss and heat load calculations
p. Calculating domestic hot water heating loads

TASK

SE-10 Sizing solar system components

PERFORMANCE OBJECTIVE

Use tables for sizing solar system components.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. F-chart calculations
b. Using the F-chart method to predict thermal performances
c. Parameters characterizing the performance of flat-plate collectors
d. Collector heat exchanger correction factor
e. Load heat exchanger correction factor
f. Collector air flow-rate correction factor
g. Liquid base solar heating systems
h. Efficiency data for air heating collectors

(Continued on back)

Provide Demonstration On:

Calculating proper size of solar system components for various types of buildings

Provide Practical Application On:

Given data on a domestic dwelling, month of the year, overnight heat load and temperature change, calculate the size of storage unit necessary.

INSTRUCTIONAL MATERIALS

Textbooks:

Fundamentals of Solar Heating

Student Manuals:

Georgia, *Solar Heating Systems*

CLASSROOM HOURS

6

EVALUATION (SE-10)

a. Given house plans for a residence, determine the proper size storage area and storage unit; size heat exchangers for a given solar system from system specifications.

b. Georgia, Solar Heating Systems, Unit SB-8.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

i. Sizing and collector efficiency
j. Sizing storage units and other components
k. Rules of thumb for sizing
    1. Solar air heating systems
    2. Solar hydronic heating/cooling systems
    3. Solar domestic hot water heating systems

TASK

SE-11 Performing a solar system economic analysis

PERFORMANCE OBJECTIVE

Determine the annual cash flow for solar and nonsolar systems, the time of payback and positive savings.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Federal and state regulations effecting the cost of solar systems
b. Energy credits for individuals (publication 903 Dept. of Treasury FRS division)
c. Local availability of mortgage money, interest rates, local mortgage companies
d. Costs of insuring solar heated dwellings
e. How taxes effect cost of solar heating
f. Life-cycle cost analysis

(Continued on back)

Provide Demonstration On:

Calculating the time of pay back and positive savings for various types of dwellings and data

Provide Practical Application On:

a. Calculate the number of years until positive savings and the number of years until payback for a given dwelling.
b. Choose an economical collector for a specific solar installation.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Lennox Solar Manual
b. Fundamentals of Solar Heating

Students Manuals:

Georgia, Solar Heating Systems

CLASSROOM HOURS 12

EVALUATION (SE-11)

a. Given the cost of purchase and installation of a solar system, annual heat load data, taxes, terms of the loan for the dwelling, insurance, etc., determine the annual cash flow for the owner of a solar system for the next 20 years.

b. Georgia, Solar Heating Systems, Unit SB-9.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

g. Measures of cost effectiveness
h. Annual expenses for solar vs. electric resistance
i. Payback calculation for solar vs. electric resistance

TASK

SE-12 Selecting a domestic solar hot water system

PERFORMANCE OBJECTIVE

Select a domestic solar hot water system for a specific application.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Types of solar DHW systems
b. Advantages of a solar DHW system
c. Components of a typical solar DHW system
d. Thermosiphon system
e. Drain-down system
f. Indirect heating/circulating system
g. Analyzing a solar DHW system
h. Designing a DHW system
i. Selecting a proper solar DHW system
j. Integrating solar DHW systems with other heating systems

Provide Demonstration On:

a. Types of DHW systems
b. Components of a DHW system

Provide Practical Application On:

Design a solar DHW system for supplying hot water to the lab the students work in.

INSTRUCTIONAL MATERIALS

Textbooks:

Fundamentals of Solar Heating

A/Vs:

Georgia, slide tape SB-10-1

Student Manuals:

Georgia, Solar Heating Systems

Tools and Equipment:

Various types of solar DHW systems for observation.

CLASSROOM HOURS 6

EVALUATION (SE-12)

a. Given the hot water requirements for a dwelling, the student will design a working solar DHW system.

b. Georgia, Solar Heating Systems, Unit SB-10.

TASK

SE-13 Selecting/fabricating correct thermal mass for a direct gain solar system

PERFORMANCE OBJECTIVE

Apply the principles of passive solar design to fabricate and install a modular wall unit.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Direct gain
b. Solar heat gain through use of glass
c. Calculating available storage capacity
d. Heat capacity for direct sunlight
e. Heat capacity for indirect sunlight
f. Thermosiphoning air heaters
g. Thermosiphoning air collectors
h. Installation of thermosiphon air panel heater
i. One way dampers for thermosiphoning air heaters

(Continued on back)

Provide Demonstration On:

a. Installation of a thermosiphon air panel heater
b. Installation of a Trombe wall

Provide Practical Application On:

a. Install a Trombe wall
b. Install a thermosiphon air panel heater
c. Calculate correct thermal mass for a direct gain system

INSTRUCTIONAL MATERIALS

Textbooks:

Colorado, Solar Heating and Cooling of Residential Buildings

A/Vs:

Georgia, slide/tape SC-1-1

Student Manuals:

Georgia, Solar Heating Systems

Tools and Equipment:

a. Solar heat gain through use of glass
b. Heat capacities

CLASSROOM HOURS

12

EVALUATION (SE-13)

a. Given proper equipment and materials, install a thermosiphon air panel heater and a Trombe wall.

b. Georgia, Solar Heating Systems, Unit SC-1.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

j. Trombe walls
k. Constructing Trombe walls
l. Thermal mass calculations

TASK

SE-14 Integrating installation of a solar system in a construction schedule

PERFORMANCE OBJECTIVE

Integrate the installation of a liquid solar system with construction of a home.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Construction of a storage tank structural base
b. Placement of collectors on roof
c. Piping
d. Testing collector loop leaks
e. Storage piping connections
f. Installation of control temperature sensors
g. Control panel installation
h. Piping insulation
i. Installation of preheat coil and domestic hot water tank

(Continued on back)

Provide Demonstration On:

a. Installing a liquid solar system
b. Scheduling installation

Provide Practical Application On:

Using a scheduled installation procedure

INSTRUCTIONAL MATERIALS

Textbooks:

Lennox Solar Manual

A/Vs:

Georgia, slide tape SC-2-1

Student Manuals:

Georgia, Solar Heating Systems

CLASSROOM HOURS 6

EVALUATION (SE-14)

a. Given data on a specific installation job, determine each step in the installation schedule.

b. Georgia, Solar Heating Systems, Unit SC-2.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

j. Removing barriers
k. Installing a liquid solar system

TASK

SE-15 Installing liquid storage tanks

PERFORMANCE OBJECTIVE

Select and install a storage tank in a given location, including building a base, leak testing and insulting.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Site location
b. Structural base requirements
c. Tank shape
d. Temperature stresses
e. Insulation
f. Bulk head connections

Provide Demonstration On:

Correct installation and leak testing procedures

Provide Practical Application On:

Prepare base, install storage tank and test for leaks and proper operation.

INSTRUCTIONAL MATERIALS

Textbooks:

Lennox Solar Manual

Student Manuals:

Georgia, Solar Heating Systems

Tools and Equipment:

a. Liquid storage tank
b. Installation materials
c. Assorted tools

CLASSROOM HOURS

12

EVALUATION (SE-15)

a. Given a thermal storage tank, tools and materials, install the tank, including base preparation and leak testing.

b. Georgia, Solar Heating Systems, Unit SC-3.

TASK

SE-16 Siting and mounting collectors

PERFORMANCE OBJECTIVE

Choose appropriate location for a solar collector, determine the requirements for roof mounting or ground mounting of the solar collector array and install roofmounting supports for both accessible and inaccessible rafter conditions.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Siting solar collectors
b. Roof mounting of collectors
c. Load bearing capacities
d. Tilt angles
e. Stand-off mounting
f. Flashed mounting block
g. Roof rack mounting
h. Wind bracing
i. Pitch pot flat roof mounting
j. Ground mounting collectors
k. Fastening mounting blocks or sleepers to the roof
    1. Spanner mounting
    2. Lag screw mounting

Provide Demonstration On:

a. Siting procedures for solar collectors
b. Mounting collectors

Provide Practical Application On:

a. Drawing a cross section of a mounted collector
b. Choose a site for a solar collector.
c. Install spanner and lag screw mounting supports.

INSTRUCTIONAL MATERIALS

Textbooks:

Colorado, Solar Heating and Cooling of Residential Buildings

Student Manuals:

Georgia, Solar Heating Systems

Tools and Equipment:

a. Spanner mounting assembly
b. Lag screw mounting assembly
c. Hand tools
d. Collectors

CLASSROOM HOURS

18

EVALUATION (SE-16)

a. Given solar collectors and a roof mounting requirement, install the roof mounting supports and the collectors.

b. Georgia, Solar Heating Systems, Unit SC-4.

TASK

SE-17 Installing liquid collectors and outside plumbing

PERFORMANCE OBJECTIVE

Install liquid collectors and outside plumbing loop and check for leaks.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Methods of collector support
b. Raising the collector to the roof
c. Positioning the collector
d. Connector hoses
e. Air vent valves
f. Flow designs
g. Cold climate designs
h. Proper roof penetration technique

Provide Demonstration On:

Proper installation procedures

Provide Practical Application On:

Fabricating and testing a simulated collector manifold

INSTRUCTIONAL MATERIALS

Textbooks:

a. *Lennox Solar Manual*
b. *Fundamentals of Solar Heating*

Student Manuals:

Georgia, *Solar Heating Systems*

Tools and Equipment:

a. Solar collectors
b. Installation materials
c. Assorted tools
d. Soldering torch and supplies

CLASSROOM HOURS 18

EVALUATION (SE-17)

a. Given liquid collectors and a site for installation, install the collectors, including all outside plumbing, and check for leaks.

b. Georgia, Solar Heating Systems, Unit SC-5.

TASK

SE-18 Installing inside plumbing for collector load-side loops

PERFORMANCE OBJECTIVE

Install all inside plumbing for a solar space heating/domestic hot water system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Open and closed loops
b. Expansion and compression tanks
c. Adding antifreeze
d. Recommended pressure head
e. Pump location
f. Laying out component locations

Provide Demonstration On:

Proper component location and installation procedures

Provide Practical Application On:

Lay out and connect the inside plumbing components for space heating and hot water systems.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Lennox Solar Manual
b. Fundamentals of Solar Heating

Student Manuals:

Georgia, Solar Heating Systems

Tools and Equipment:

a. Inside plumbing components, lines, tubing, clamps, etc.
b. Assorted tools

CLASSROOM HOURS 18

EVALUATION (SE-18)

a. Given the components and the specifications for a solar space heating system and for a hot water system, install all inside plumbing components for the systems.

b. Georgia, Solar Heating Systems, Unit SC-6.

TASK

SE-19 Installing controls and wiring

PERFORMANCE OBJECTIVE

Wire a liquid closed-loop solar space heating system.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Wiring a control system
b. Gauging wire
c. Sizing fuses
d. Placement of conduits
e. Placement of control panel
f. Placement of collector sensor
g. Sensor wiring
h. Remote sensing bulb
i. Purge aquastat control
j. Storage sensor
k. Storage aquastat
l. Closed-loop, solar space heating system
m. Control valves
n. Absorber plate
o. Wiring a domestic hot water system

Provide Demonstration On:

a. Wiring a solar liquid closed-loop space heating system
b. Control systems in a heating system

Provide Practical Application On:

Wiring a control system

INSTRUCTIONAL MATERIALS

Textbooks:

Lennox Solar Manual

Student Manuals:

Georgia, Solar Heating Systems

Tools and Equipment:

a. Hot water system
b. Hand tools
c. Wiring
d. Fuses

CLASSROOM HOURS 24

EVALUATION (SE-19)

a. Given proper equipment and materials, the student will correctly wire a domestic solar hot water system.

b. Georgia, Solar Heating Systems, Unit SC-7.

TASK

SE-20 Filling and starting the system

PERFORMANCE OBJECTIVE

Fill and flush the solar system, test for and repair leaks, charge the system, balance flows, and put into operation.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Filling and flushing medium
b. Filling and flushing procedure
c. Leak testing procedures
d. Repairing leaks
e. Charging the collector loop
f. Charging the load loop
g. Balancing flows
h. Start up procedures
i. Operational adjustments

Provide Demonstration On:

Correct procedures for filling, flushing, leak testing, repairing, charging, balancing and starting up the system

Provide Practical Application On:

Fill and start a domestic solar hot water system.

INSTRUCTIONAL MATERIALS

Textbooks:

Lennox Solar Manual

Student Manuals:

Georgia, Solar Heating Systems

Tools and Equipment:

An installed solar heating system ready to be filled and started

CLASSROOM HOURS 9

EVALUATION (SE-20)

a. Given a solar heating system installed and ready for filling and starting, fill and flush the system, check for and repair leaks, charge the system, balance fluid flows and start up the system.

b. Georgia, Solar Heating Systems, Unit SC-8.

TASK

SE-21 Maintaining a solar system

PERFORMANCE OBJECTIVE

Construct a maintenance schedule for a solar system and carry out maintenance procedures.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Checklist for maintaining a solar system
b. Repairing and replacing component parts
c. Determining malfunctions in the electrical system
d. Determining malfunctions in the solar system

Provide Demonstration On:

Checking out a working solar system

Provide Practical Application On:

a. Construct a maintenance schedule for a working solar system.
b. Carry out maintenance procedures.

INSTRUCTIONAL MATERIALS

Textbooks:

Fundamentals of Solar Heating

Student Manual:

Georgia, Solar Heating Systems

Tools and Equipment:

a. Working solar system
b. Hand tools
c. Maintenance supplies

CLASSROOM HOURS 30

EVALUATION (SE-21)

a. Given a solar heating system, the student will construct a maintenance schedule and carry out the prescribed maintenance activities.

b. Georgia, Solar Heating Systems, Unit SD-1.

TASK

SE-22 Troubleshooting solar system problems

PERFORMANCE OBJECTIVE

Diagnose and repair problems in solar system operation.

INSTRUCTIONAL ACTIVITIES

Provide Information On:

a. Diagnosis by symptom
b. Electrical problems
c. Mechanical problems
d. Fluid problems
e. Corrosion
f. Leaks
g. Improper installation
h. Improper fluids
i. Improper sizing of collectors or storage
j. Collection malfunction
k. Storage malfunction
l. Control device malfunction

Provide Demonstration On:

a. Proper electrical diagnosis procedures
b. Proper mechanical diagnosis procedures
c. Diagnosing fluid problems

Provide Practical Application On:

Diagnose and repair malfunctions in electrical components, mechanical components, and fluid problems in solar systems.

INSTRUCTIONAL MATERIALS

Textbooks:

a. Fundamentals of Solar Heating
b. Lennox Solar Manual

Student Manuals:

Georgia, Solar Heating Systems

Tools and Equipment:

a. Solar systems with electrical and mechanical malfunctions
b. Testing equipment
c. Assorted tools

CLASSROOM HOURS

40

EVALUATION (SE-22)

a. Given solar heating systems and components with electrical, mechanical and fluid problems, the student will accurately diagnose and repair the problems so that the system or component is fully operational.

b. Georgia, Solar Heating Systems, Unit SD-2.

SECTION VI

REFERENCES, RESOURCES

RESOURCES

Instructional Resource Matrix

The Instructional Resource Matrix lists the instructional resources required to carry out the learning activities in each unit in the program. The resources are divided into the categories of audio visuals, textbooks and student materials.

Audio visuals are identified by the following symbols: slide/tapes (ST) and filmstrips (FS).

Textbooks are identified by the author(s)/publisher and title.

Textbook List

This list identifies the textbooks referenced in the Unit Guide section and on the Instructional Resource Matrix.

Audio Visuals

The suppliers of the audio visuals referenced on the Unit Guides and the Instructional Resource Matrix are listed.

Additional Instructional Resources

This section lists instructional resources which may be used in addition to those primary resources listed on the Unit Guides.

Resource Addresses

Addresses of instructional materials referenced on the Unit Guides and in the Additional Instructional Resources section are given.

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
EL-01	Using basic electrical theory	Georgia: "Understanding Basic Electrical Theory" (ST)	Smith: *Electricity for Refrigeration, Heating and Air Conditioning*	Georgia: *Electricity*, Unit EL-01
EL-02	Computing Ohm's law and power formulas		Smith: *Electricity for Refrigeration, Heating and Air Conditioning*	Georgia: *Electricity*, Unit EL-02
EL-03	Using electric meters	Georgia: "Using Electric Meters" (ST)	Smith: *Electricity for Refrigeration, Heating and Air Conditioning*	Georgia: *Electricity*, Unit EL-03
EL-04	Understanding series and parallel circuits	Georgia: "Demonstrating a Knowledge of Series and Parallel Circuits" (ST)	Smith: *Electricity for Refrigeration, Heating and Air Conditioning*	Georgia: *Electricity*, Unit EL-04
EL-05	Identifying electrical symbols	Georgia: "Identifying Symbols" (ST)	Smith: *Electricity for Refrigeration, Heating and Air Conditioning*	Georgia: *Electricity*, Unit EL-05
EL-06	Reading a basic schematic diagram	Georgia: "Reading a Basic Schematic Diagram" (ST)	Smith: *Electricity for Refrigeration, Heating and Air Conditioning*	Georgia: *Electricity*, Unit EL-06
EL-07	Reading advanced schematic diagrams		Smith: *Electricity for Refrigeration, Heating and Air Conditioning*	Georgia: *Electricity*, Unit EL-07
EL-08	Applying alternating current principles		Smith: *Electricity for Refrigeration, Heating and Air Conditioning*	Georgia: *Electricity*, Unit EL-08
EL-09	Determining and selecting wire size and making connections	Georgia: "Determining, Selecting Wire Size and Making Connections" (ST)	Smith: *Electricity for Refrigeration, Heating and Air Conditioning*	Georgia: *Electricity*, Unit EL-09

RESOURCES

Instructional Resource Matrix

The Instructional Resource Matrix lists the instructional resources required to carry out the learning activities in each unit in the program. The resources are divided into the categories of audio visuals, textbooks and student materials.

Audio visuals are identified by the following symbols: slide/tapes (ST) and filmstrips (FS).

Textbooks are identified by the author(s)/publisher and title.

Textbook List

This list identifies the textbooks referenced in the Unit Guide section and on the Instructional Resource Matrix.

Audio Visuals

The suppliers of the audio visuals referenced on the Unit Guides and the Instructional Resource Matrix are listed.

Additional Instructional Resources

This section lists instructional resources which may be used in addition to those primary resources listed on the Unit Guides.

Resource Addresses

Addresses of instructional materials referenced on the Unit Guides and in the Additional Instructional Resources section are given.

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
EL-01 Using basic electrical theory	Georgia: "Understanding Basic Electrical Theory" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-01
EL-02 Computing Ohm's law and power formulas		Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-02
EL-03 Using electric meters	Georgia: "Using Electric Meters" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-03
EL-04 Understanding series and parallel circuits	Georgia: "Demonstrating a Knowledge of Series and Parallel Circuits" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-04
EL-05 Identifying electrical symbols	Georgia: "Identifying Symbols" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-05
EL-06 Reading a basic schematic diagram	Georgia: "Reading a Basic Schematic Diagram" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-06
EL-07 Reading advanced schematic diagrams		Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-07
EL-08 Applying alternating current principles		Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-08
EL-09 Determining and selecting wire size and making connections	Georgia: "Determining, Selecting Wire Size and Making Connections" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-09

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
EL-10	Making main panel connections	Georgia: "Making Main Panel Connections" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-10
EL-11	Servicing shaded pole motors	Georgia: "Servicing Shaded Pole Motors" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-11
EL-12	Wiring split-phase motors	Georgia: "Servicing Shaded Pole Motors" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-12
EL-13	Checking capacitors	Georgia: "Checking Capacitors" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-13
EL-14	Hooking up and troubleshooting PSC motors		Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-14
EL-15	Hooking up and troubleshooting CS motors	Georgia: "Hooking Up and Troubleshooting CS Motors" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-15
EL-16	Hooking up and troubleshooting CSR motors	Georgia: "Hooking Up and Troubleshooting CSR Motors" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-16
EL-17	Connecting three phase motors		Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-17
EL-18	Testing motors		Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-18

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
EL-19 Maintaining electric motors		Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-19
EL-20 Installing and testing transformers	Georgia: "Installing and Testing a Transformer" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-20
EL-21 Installing and testing contactors and relays	Georgia: "Installing and Testing Contactors and Relays" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-21
EL-22 Installing and checking thermostats	Georgia: "Installing and Checking Thermostats" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-22
EL-23 Installing and checking pressure switches	Georgia: "Installing and Checking Pressure Switches" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-23
EL-24 Troubleshooting overload devices		Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-24
EL-25 Installing and checking various electric control devices	Georgia: "Installing and Checking Miscellaneous Controls" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-25
EL-26 Troubleshooting magnetic starters	Georgia: "Troubleshooting Magnetic Starters" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-26
EL-27 Wiring packaged air conditioners	Georgia: "Wiring Packaged Air Conditioners" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-27

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
EL-28	Wiring split system air conditioning units	Georgia: "Wiring Split System Air Conditioning" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-28
EL-29	Designing a control panel		Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-29
EL-30	Designing an advanced control panel		Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-30
EL-31	Troubleshooting a basic electrical control system	Georgia: "Troubleshooting Electrical Control Systems" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-31
EL-32	Advanced troubleshooting of electrical control systems		Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-32
EL-33	Servicing solid-state control circuits	Georgia: "Servicing Solid State Control Circuits" (ST)	Smith: Electricity for Refrigeration, Heating and Air Conditioning	Georgia: Electricity, Unit EL-33

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
RF-01 Becoming familiar with career opportunities in refrigeration		Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Doolin: Doolin's Trouble Shooters Bible	Georgia: Refrigeration, Unit REF-01; Copeland Corp.: Refrigeration Manuals
RF-02 Identifying safe working conditions	Georgia: "Identifying Safe Working Conditions" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Carrier Corp.: A Safety Guide for Refrigeration and Air Conditioning	Georgia: Refrigeration, Unit REF-02
RF-03 Demonstrating a knowledge of the basic refrigeration concepts	Georgia: "Understanding Basic Refrigeration Concepts" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning	Georgia: Refrigeration, Unit REF-03; Copeland Corp.: Refrigeration Manuals
RF-04 Demonstrating knowledge of the basic refrigeration cycle	Georgia: "Understanding the Basic Refrigeration Cycle" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-04; Copeland Corp.: Refrigeration Manuals
RF-05 Using refrigeration tools	Georgia: "Identifying Tools" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-05

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
RF-06 Tapping, threading and replacing threads	Georgia: "Tapping, Threading and Replacing Threads" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-06
RF-07 Becoming familiar with fitting nomenclature and pipe materials		Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-07
RF-08 Performing basic copper tubing operations	Georgia: "Basic Copper Tubing Operations" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-08
RF-09 Soft soldering copper tubing	Georgia: "Soft Soldering Copper Tubing" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-09
RF-10 Silver brazing	Georgia: "Silver Brazing" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-10

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
RF-11 Handling refrigerants	Georgia: "Handling Refrigerants" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-11; Copeland Corp.: Refrigeration Manuals
RF-12 Installing and using access valves	Georgia: "Using Access Valves" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-12; Copeland Corp.: Refrigeration Manuals
RF-13 Maintaining refrigeration manifold gauges	Georgia: "Maintaining Refrigeration Manifold Gauges" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-13; Copeland Corp.: Refrigeration Manuals
RF-14 Installing and using refrigeration manifold gauges	Georgia: "Installing and Using Refrigeration Manifold Gauges" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-14; Copeland Corp.: Refrigeration Manuals
RF-15 Evacuating a refrigeration system	Georgia: "Using a Vacuum Pump" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-15; Copeland Corp. : Refrigeration Manuals; Carrier: GTR Manuals

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
RF-16 Installing refrigeration accessories	Georgia: "Installing Refrigeration Accessories" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-16; Copeland Corp.: Refrigeration Manuals; Carrier: GTR Manuals
RF-17 Testing for leaks	Georgia: "Testing for Leaks" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-17; Copeland Corp.: Refrigeration Manuals; Carrier: GTR Manuals
RF-18 Charging the system	Georgia: "Charging the System" (ST); Westinghouse: (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-18; Copeland Corp.: Refrigeration Manuals; Carrier: GTR Manuals
RF-19 Testing the compressor	Georgia: "Testing the Compressor" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-19; Copeland Corp.: Refrigeration Manuals; Carrier: GTR Manuals
RF-20 Troubleshooting condensers	Carrier: (GTR-4)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia; Refrigeration, Unit REF-20; Copeland Corp.: Refrigeration Manuals; Carrier: GTR Manuals

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
RF-21 Troubleshooting evaporators	Carrier: Refrigeration slides (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-21; Copeland Corp.: Refrigeration Manuals; Carrier: GTR Manuals
RF-22 Troubleshooting an automatic expansion valve		Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-22; Copeland Corp.: Refrigeration Manuals; Carrier: GTR Manuals
RF-23 Troubleshooting capillary tubes		Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-23; Copeland Corp.: Refrigeration Manuals; Carrier: GTR Manuals
RF-24 Troubleshooting thermostatic expansion valves	Georgia: "Troubleshooting a Thermostatic Expansion Valve"	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-24; Copeland Corp.: Refrigeration Manuals; Carrier: GTR Manuals
RF-25 Troubleshooting the refrigeration system		Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Refrigeration	Georgia: Refrigeration, Unit REF-25; Copeland Corp.: Refrigeration Manuals; Carrier: GTR Manuals

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
AC-01 Identifying major components and functions of air conditioning systems	Georgia: "Demonstrate a Knowledge of Air Conditioning Systems" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Air Conditioning	Georgia: Air Conditioning, Unit AC-01
AC-02 Applying basic air principles	Georgia: "Applying Basic Air Principles" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Air Conditioning; Carrier Corp.: Carrier Manual	Georgia: Air Conditioning, Unit AC-02
AC-03 Calculating heat loads	Georgia: "Calculating Heat Loads" (ST)	Delmar: Principles of Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning	Georgia: Air Conditioning, Unit AC-03
AC-04 Applying principles of air movement	Georgia: "Applying Principles of Air Movement" (ST)	Delmar: Principles of Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning	Georgia: Air Conditioning, Unit AC-04
AC-05 Servicing air filtering systems	Georgia: "Identifying Air Filtering Systems" (ST)	Delmar: Principles of Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning	Georgia: Air Conditioning, Unit AC-05

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
AC-06 Installing a window air conditioning unit	Georgia: "Installation of a Window Unit" (ST)	Delmar: Principles of Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning	Georgia: Air Conditioning, Unit AC-06
AC-07 Performing pre-season start up maintenance on window air conditioning units	Georgia: "Performing Pre-Season Start-Up" (ST)	Delmar: Principles of Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning	Georgia: Air Conditioning, Unit AC-07
AC-08 Troubleshooting compressor burnout in window air conditioners	Georgia: "Troubleshooting Compressor Burn Out in a Window Air Conditioner" (ST)	Delmar: Principles of Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning	Georgia: Air Conditioning, Unit AC-08
AC-09 Evacuating and charging window air conditioners	Georgia: "Evacuating and Charging a Window Air Conditioner" (ST)	Delmar: Principles of Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning	Georgia: Air Conditioning, Unit AC-09
AC-10 Troubleshooting fans and fan motors	Georgia: "Troubleshooting Fans and Fan Motors" (ST)	Delmar: Principles of Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning	Georgia: Air Conditioning, Unit AC-10

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
AC-11 Troubleshooting mechanical problems in window air conditioner refrigeration cycle	Georgia: "Troubleshooting Window Air Conditioner Refrigeration Cycle" (ST)	Delmar: Principles of Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning	Georgia: Air Conditioning, Unit AC-11
AC-12 Troubleshooting a window air conditioner electrical system	Georgia: "Troubleshooting a Window Air Conditioning Electrical System" (ST)	Delmar: Principles of Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning	Georgia: Air Conditioning, Unit AC-12
AC-13 Installing condensate drains	Georgia: "Installing Condensate Drain" (ST)	Delmar: Principles of Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning	Georgia: Air Conditioning, Unit AC-13
AC-14 Installing residential and mobile home package air conditioning units	Georgia: "Installing Package Unit (Residential and Mobile Home)" (ST)	Delmar: Principles of Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning	Georgia: Air Conditioning, Unit AC-14
AC-15 Installing split system air conditioning units	Georgia: "Installing Split System" (ST)	Delmar: Principles of Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning; Doolin: Doolin's Trouble Shooters Bible	Georgia: Air Conditioning, Unit AC-15

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
AC-16 Installing add-on split air conditioning systems	Georgia: "Installing Add-on Split Systems" (ST)	Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning; Doolin: Doolin's Trouble Shooters Bible	Georgia: Air Conditioning, Unit AC-16
AC-17 Troubleshooting compressor burnout	Georgia: "Troubleshooting Compressor Burnout" (ST)	Delmar: Principles of Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning; Doolin: Doolin's Trouble Shooters Bible	Georgia: Air Conditioning, Unit AC-17
AC-18 Troubleshooting fans and fan motors	Georgia: "Troubleshooting Fans and Fan Motors" (ST)	Delmar: Principles of Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning; Doolin: Doolin's Trouble Shooters Bible	Georgia: Air Conditioning, Unit AC-18
AC-19 Performing pre-season start up and air conditioner service	Georgia: "Performing Pre-Season Start UP" (ST)	Delmar: Principles of Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning; Doolin: Doolin's Trouble Shooters Bible	Georgia: Air Conditioning, Unit AC-19

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
AC-20 Troubleshooting air conditioner refrigeration cycle	Georgia: "Troubleshooting Conditioners (Refrigeration Cycle)" (ST)	Delmar: Principles of Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning; Doolin: Doolin's Trouble Shooters Bible	Georgia: Air Conditioning, Unit AC-20
AC-21 Troubleshooting air conditioner electrical cycle		Delmar: Principles of Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning; Doolin: Doolin's Trouble Shooters Bible	Georgia: Air Conditioning, Unit AC-21
AC-22 Troubleshooting air conditioner air movement	Georgia: "Troubleshooting Air Conditioners (Air Movement)" (ST)	Delmar: Principles of Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Prentice-Hall: Refrigeration and Air Conditioning; Doolin: Doolin's Trouble Shooters Bible	Georgia: Air Conditioning, Unit AC-22
AC-23 Applying principles of the heat pump	Georgia: "Understanding Principles of the Heat Pump" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Air Conditioning	Georgia: Heat Pumps, Unit AC-23

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
AC-24	Evacuating and charging the heat pump		Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Air Conditioning	Georgia: Heat Pumps, Unit AC-24
AC-25	Installing a reversing valve		Prentice-Hall: Refrigeration and Air Conditioning; Delmar: Principles of Air Conditioning	Georgia: Heat Pumps, Unit AC-25
AC-26	Tracing the heat pump refrigeration cycle	Georgia: "Refrigeration Cycle and Components" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Air Conditioning	Georgia: Heat Pumps, Unit AC-26
AC-27	Installing electrical circuits	Georgia: "Inspecting Electrical Circuits" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Air Conditioning	Georgia: Heat Pumps, Unit AC-27
AC-28	Adjusting and repairing defrost controls	Georgia: "Adjusting and Repairing Defrost Controls" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Air Conditioning	Georgia: Heat Pumps, Unit AC-28

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
AC-29 Installing package heat pumps	Georgia: "Installing Package Heat Pumps" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Air Conditioning	Georgia: Heat Pumps, Unit AC-29
AC-30 Installing split-system heat pumps	Georgia: "Installing Split System Heat Pumps" (ST)	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Delmar: Principles of Air Conditioning	Georgia: Heat Pumps, Unit AC-30

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
HE-01 Applying principles of electric furnaces and controls	Georgia: "Applying Principles of Electric Furnaces and Controls" (ST); Carrier: Heating Slides	Althouse: Modern Refrigeration and Air Conditioning; Cooper: Warm Air Heating for Climate Control; Manufacturer's instruction and operation manuals	Georgia: Heating, Unit HE-01
HE-02 Installing electric furnaces	Carrier: Heating Slides	Prentice-Hall: Refrigeration and Air Conditioning; Althouse: Modern Refrigeration and Air Conditioning; Cooper: Warm Air Heating for Climate Control; Manufacturer's instruction and operation manuals	Georgia: Heating, Unit HE-02
HE-03 Troubleshooting electric furnaces	Georgia: "Troubleshooting Electric Furnaces" (ST); Carrier: Heating Slides	Manufacturer's instructions for electric furnaces; Cooper: Warm Air Heating for Climate Control	Georgia: Heating, Unit HE-03
HE-04 Applying gas fuel combustion and safety principles	Georgia: "Applying Gas Fuel Combustion and Safety Principles" (ST)	Althouse: Modern Refrigeration and Air Conditioning; Carrier: Gas Piping and Combustion; Cooper: Warm Air Heating for Climate Control	Georgia: Heating, Unit HE-04
HE-05 Identifying major components and functions of gas heating systems	Georgia: "Understanding Basic Gas Systems" (ST); Carrier: Heating Slides	Cooper: Warm Air Heating for Climate Control; Carrier Heating Manual	Georgia: Heating, Unit HE-05

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio-Visuals	Textbooks	Student Materials
HE-06	Checking gas sources	Georgia: "Checking Gas Sources" (ST); Carrier: Heating Slides	Althouse: Modern Refrigeration and Air Conditioning; Carrier Heating Manual	Georgia: Heating, Unit HE-06
HE-07	Applying gas piping principles	Georgia: "Gas Piping Principles" (ST); Carrier: Heating Slides	Cooper: Warm Air Heating for Climate Control; Carrier Heating Manual	Georgia: Heating, Unit HE-07
HE-08	Installing and adjusting gas regulators	Georgia: "Adjusting Regulators" (ST); Carrier: Heating Slides	Cooper: Warm Air Heating for Climate Control; Carrier Heating Manual	Georgia: Heating, Unit HE-08
HE-09	Installing and servicing gas valves	Georgia: "Installing and Servicing Gas Valves" (ST); Carrier: Heating Slides	Cooper: Warm Air Heating for Climate Control; Carrier Heating Manual	Georgia: Heating, Unit HE-09
HE-10	Installing and servicing pilot ignition devices	Georgia: "Installing and Servicing Pilot Ignition Devices" (ST); Carrier: Heating Slides	Althouse: Modern Refrigeration and Air Conditioning; Cooper: Warm Air Heating for Climate Control; Carrier Heating Manual	Georgia: Heating, Unit HE-10
HE-11	Installing and servicing combination gas valves	Georgia: "Installing and Servicing Combination Gas Valves" (ST); Carrier: Heating Slides	Althouse: Modern Refrigeration and Air Conditioning; Cooper: Warm Air Heating for Climate Control; Carrier Heating Manual	Georgia: Heating, Unit HE-11
HE-12	Servicing gas burners	Georgia: "Servicing Gas Burners" (ST); Carrier: Heating Slides	Cooper: Warm Air Heating for Climate Control; Carrier Heating Manual	Georgia: Heating, Unit HE-12
HE-13	Inspecting and adjusting termperature rise of heat exchangers	Georgia: "Inspecting and Determining Temperature Rise of Heat Exchangers" (ST); Carrier: Heating Slides	Cooper: Warm Air Heating for Climate Control; Carrier Heating Manual	Georgia: Heating, Unit HE-13

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
HE-14 Venting gas heating systems	Carrier: Heating Slides	Prentice-Hall: Refrigeration and Air Conditioning; Carrier Heating Manual	Georgia: Heating, Unit HE-14
HE-15 Servicing gas furnace electrical controls	Georgia: "Servicing Electrical Controls" (ST); Carrier: Heating Slides	Cooper: Warm Air Heating for Climate Control; Carrier Heating Manual	Georgia: Heating, Unit HE-15
HE-16 Determining combustion efficiency	Georgia: "Determining Combustion Efficiency" (ST); Carrier: Heating Slides	Cooper: Warm Air Heating for Climate Control; Carrier Heating Manual	Georgia: Heating, Unit HE-16
HE-17 Performing a preseason check-up and start-up on a gas furnace	Georgia: "Performing Pre-Season Check-Up and Start-Up" (ST)	Althouse: Modern Refrigeration and Air Conditioning; Cooper: Warm Air Heating for Climate Control; Manufacturer's instruction and maintenance manual	Georgia: Heating, Unit HE-17
HE-18 Troubleshooting the gas heating system		Cooper: Warm Air Heating for Climate Control; Carrier Heating Manual	Georgia: Heating, Unit HE-18
HE-19 Identifying types of fuel oil and principles of combustion		Burkhardt: Domestic and Commercial Oil Burners; Carrier: Oil Burners	Georgia: Heating, Unit HE-19
HE-20 Designing and installing oil piping		Burkhardt: Domestic and Commercial Oil Burners; Georgia State Code	Georgia: Heating, Unit HE-20
HE-21 Installing oil burners	Georgia: "Installing Oil Burners" (ST)	Burkhardt: Domestic and Commercial Oil Burners	Georgia: Heating, Unit HE-21

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio-Visuals	Textbooks	Student Materials
HE-22 Installing and servicing transformers and electrodes	Georgia: "Installing and Servicing Transformers and Electrodes" (ST)	Burkhardt: Domestic and Commercial Oil Burners; Field: Oil Burners	Georgia: Heating, Unit HE-22
HE-23 Installing oil pumps	Georgia: "Installing Oil Pumps" (ST)	Burkhardt: Domestic and Commercial Oil Burners; Althouse: Modern Refrigeration and Air Conditioning	Georgia: Heating, Unit HE-23
HE-24 Servicing blower, nozzle, motor and coupling		Burkhardt: Domestic and Commercial Oil Burners; Field: Oil Burners; Cooper: Warm Air Heating for Climate Control	Georgia: Heating, Unit HE-24
HE-25 Performing the combustion efficiency test	Georgia: "Installing Vent and Heat Exchanger" (ST)	Burkhardt: Domestic and Commercial Oil Burners; Georgia State Code	Georgia: Heating, Unit HE-25
HE-26 Installing controls		Burkhardt: Domestic and Commercial Oil Burners; Field: Oil Burners	Georgia: Heating, Unit HE-26
HE-27 Performing pre-season start-up and check-up on an oil burning heating system	Georgia: "Performing Pre-Season Start-Up and Check-Ups" (ST)	Burkhardt: Domestic and Commercial Oil Burners; Cooper: Warm Air Heating for Climate Control; Manufacturer's operating and maintenance manuals	Georgia: Heating, Unit HE-27
HE-28 Troubleshooting the oil burning heating system	Georgia: "Troubleshooting the Oil Burning Heat System" (ST)	Burkhardt: Domestic and Commercial Oil Burners; Cooper: Warm Air Heating for Climate Control; Manufacturer's manuals	Georgia: Heating, Unit HE-28

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio Visuals	Textbooks	Student Materials
SM-01	Identifying materials used in sheet metalwork	Bergwall Productions, Inc. : "Sheet Metalwork, Introduction and Overview" (FS)	Johnson: Technical Metals; Feirer: Metalwork	
SM-02	Developing sheet metal patterns (stretchouts)	Bergwall Productions, Inc. : "Straight Line Pattern Development" (FS); Bergwall Productions, Inc. : "Parallel and Radial Line Pattern Development" (FS)	Johnson: Technical Metals; Feirer: Metalwork	
SM-03	Cutting sheet metal	Prentice-Hall Media: "Cutting Sheet Metal" (FS); Bergwall Productions, Inc. : "Cutting Methods" (FS)	Johnson: Technical Metals; Feirer: Metalwork	
SM-04	Bending sheet metal by hand	Bergwall Productions, Inc. : "Forming and Bending -Part 2" (FS)	Johnson: Technical Metals; Feirer: Metalwork	
SM-05	Bending metal on a bar folder or brake	Bergwall Productions, Inc. : "Drilling, Forming and Bending - Part 1" (FS)	Johnson: Technical Metals; Feirer: Metalwork	
SM-06	Roll-forming sheet metal		Johnson: Technical Metals; Feirer: Metalwork	
SM-07	Making seams	Prentice-Hall Media: "Seams and Joints" (FS); Bergwall Productions, Inc. : "Assembly and Fastening" (FS)	Johnson: Technical Metals; Feirer: Metalwork	
SM-08	Using the rotary machine		Johnson: Technical Metals; Feirer: Metalwork	

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
SM-09 Fastening sheet metal	Bergwall Productions, Inc.: "Assembly and Fastening" (FS); Prentice-Hall Media: "Riveting and Fastening" (FS); Prentice-Hall Media: "Making Holes in Sheet Metal" (FS)	Johnson, Technical Metals; Feirer, Metalwork	
SM-10 Cutting and welding sheet metal using oxyacetylene equipment	Georgia: Welding, Phase A (ST)	Georgia: Welding, Instructor Guide; Giachino and Weeks: Welding Skills and Practices; Griffin: Basic Oxyacetylene; Althouse: Modern Welding; Oregon: Welding	Georgia: Welding, Phase A
SM-11 Welding sheet metal using metal arc welding equipment	Georgia: Welding, Phase B (ST)	Georgia: Welding, Instructor Guide; Giachino and Weeks: Welding Skills and Practices; Griffin: Basic Welding; Althouse: Modern Welding	Georgia: Welding, Phase B
SM-12 Soft soldering sheet metal	Prentice-Hall Media: "Soldering" (FS); Bergwall Productions, Inc.: "Assembly and Fastening" (FS)	Johnson: Technical Metals; Feirer: Metalwork	Georgia: Welding, Phase A, Unit A-20

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING		INSTRUCTIONAL MATERIAL REFERENCES		
		Audio Visuals	Textbooks	Student Materials
SE-01	Demonstrating knowledge of the basic principles of solar energy and solar radiation	Georgia: SA-1-1 and SA-1-2 (ST)	SMACCNA: Fundamentals of Solar Heating	Georgia: Solar Heating Systems
SE-02	Identifying basic solar system components and their function	Georgia: SA-2-1 (SS)	SMACCNA: Fundamentals of Solar Heating	Georgia: Solar Heating Systems
SE-03	Conducting an energy audit of a residence		Georgia Tech.: Craftsman's Guide	Georgia: Solar Heating Systems
SE-04	Selecting passive solar approaches for new construction	Georgia: SB-2-1, SB-2-2, SB-2-3, SB-2-4, SB-2-5 (SS)	AIA: A Survey of Passive Solar Buildings	Georgia: Solar Heating Systems
SE-05	Selecting solar collectors	Georgia: SB-3-1 and SB-3-2 (SS)	SMACCNA: Fundamentals of Solar Heating	Georgia: Solar Heating Systems
SE-06	Selecting and siting thermal storage units		SMACCNA: Fundamentals of Solar Heating	Georgia: Solar Heating Systems
SE-07	Selecting control devices		SMACCNA: Fundamentals of Solar Heating; Lennox Solar Manual	Georgia: Solar Heating Systems
SE-08	Identifying and describing modes of solar system operation	Georgia: SM-6-1 (SS)	Lennox Solar Manual; SMACCNA: Fundamentals of Solar Heating	Georgia: Solar Heating Systems

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
SE-09 Calculating heat load for space or domestic hot water heating		SMACCNA: Fundamentals of Solar Heating	Georgia: Solar Heating Systems
SE-10 Sizing solar system components		SMACCNA: Fundamentals of Solar Heating	Georgia: Solar Heating Systems
SE-11 Performing a solar system economic analysis		Lennox Solar Manual; SMACCNA: Fundamentals of Solar Heating	Georgia: Solar Heating Systems
SE-12 Selecting a domestic solar hot water system	Georgia: SB-10-1 (ST)	SMACCNA: Fundamentals of Solar Heating	Georgia: Solar Heating Systems
SE-13 Selecting/fabricating correct thermal mass for a direct gain solar system	Georgia: SC-1-1 (ST)	Colorado: Solar Heating and Cooling of Residential Buildings	Georgia: Solar Heating Systems
SE-14 Integrating installation of a solar system in a construction schedule	Georgia: SC-2-1 (ST)	Lennox Solar Manual	Georgia: Solar Heating Systems
SE-15 Installing liquid storage tanks		Lennox Solar Manual	Georgia: Solar Heating Systems
SE-16 Siting and mounting collectors		Colorado: Solar Heating and Cooling of Residential Buildings	Georgia: Solar Heating Systems

CURRICULUM AREA: Refrigeration, Heating and Air Conditioning

TASK LISTING	INSTRUCTIONAL MATERIAL REFERENCES		
	Audio Visuals	Textbooks	Student Materials
SE-17 Installing liquid collectors and outside plumbing		*Lennox Solar Manual*; SMACCNA: *Fundamentals of Solar Heating*	Georgia: *Solar Heating Systems*
SE-18 Installing inside plumbing for collector load-side loops		*Lennox Solar Manual*; SMACCNA: *Fundamentals of Solar Heating*	Georgia: *Solar Heating Systems*
SE-19 Installing controls and wiring		*Lennox Solar Manual*	Georgia: *Solar Heating Systems*
SE-20 Filling and starting the system		*Lennox Solar Manual*	Georgia: *Solar Heating Systems*
SE-21 Maintaining a solar system		SMACCNA: *Fundamentals of Solar Heating*	Georgia: *Solar Heating Systems*
SE-22 Troubleshooting solar system problems		SMACCNA: *Fundamentals of Solar Heating*; *Lennox Solar Manual*	Georgia: *Solar Heating Systems*

TEXTBOOKS

A.I.A. (American Institute of Architects), A Survey of Passive Solar Buildings. Washington, DC: U.S. Superintendent of Documents, 1978.

Althouse, A.D., Turnquist, C.H. and Bracciano, A.F., Modern Refrigeration and Air Conditioning. South Holland, IL: Goodheart-Willcox, 1975.

Althouse, A.D., Turnquist, C.H. and Bowditch, William A., Modern Welding. South Holland, IL: Goodheart-Willcox, 1976.

Burkhardt, C.H., Domestic and Commercial Oil Burners: Installation and Servicing. New York, NY: McGraw-Hill, 1969.

Carrier Corporation, Air Conditioning Fundamentals. Syracuse, NY: Carrier Corporation.

Colorado State University, Solar Heating and Cooling of Residential Buildings: Design of Systems. Washington, DC: U.S. Superintendent of Documents, 1977.

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Doolin, J.H., Doolin's Trouble Shooters Bible. Dallas, TX: Doolco, Inc., 1963.

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Georgia Department of Education, Solar Heating Systems Curriculum, Instructor Guide. Atlanta, GA: Vocational Curriculum Center, Georgia Department of Education, 1979.

Georgia Department of Education, Welding, Instructor Guide. Vols. I and II. Athens, GA: Vocational Education Materials Center, 1980.

Georgia Institute of Technology, Craftsman's Guide to Energy Conservation. Atlanta, GA: Energy Development Division, Georgia Institute of Technology, 1978.

Giachino, Joseph W. and Weeks, William, Welding Skills and Practices. Chicago, IL: American Technical Society, 1976.

Griffin, Ivan H., Roden, Edward M. and Briggs, Charles W., Basic Arc Welding. Albany, NY: Delmar Publishers.

Griffin, Ivan H., Roden, Edward M. and Briggs, Charles W., Basic Oxyacetylene Welding. Albany, NY: Delmar Publishers.

Johnson, H.V., Technical Metals. Peoria, IL: Bennett Publishing Co., 1981.

Lang, Paul V., Principles of Air Conditioning. Albany, NY: Delmar Publishers, 1979.

Lennox Industries, Inc., Lennox Solar Manual. Dallas, TX: Lennox Education Products, 1979.

Marsh, R. Warren and Olivo, C. Thomas, Principles of Refrigeration. Albany, NY: Delmar Publishers, 1979.

Oregon, Welding. Individualized Learning Systems. Portland, OR: DCE Publications, 1975.

Prentice-Hall Publishing Company, Refrigeration and Air Conditioning. (Prepared by the Air Conditioning and Refrigeration Insititute). Englewood Cliffs, NJ: Prentice-Hall, 1979.

SMACCNA, (Sheet Metal and Air Conditioning Contractors National Association), Fundamentals of Solar Heating. Washington, DC: U.S. Superintendent of Documents, 1979.

Smith, R.E., Electricity for Refrigeration, Heating and Air Conditioning. North Scituate, MA: Duxbury Press (Division of Wadsworth Publishing Co.), 1978.

AUDIO-VISUALS

Bergwall Productions, Inc., filmstrips in metalworking

Carrier Corporation, slide/tapes

GTA series (Air Conditioning)
GTE series (Electricity)
GTH series (Heating)
GTR series (Refrigeration)

Georgia Department of Education, Atlanta, GA: Office of Vocational Education, slide/tape sets:

*"Air Conditioning"

*"Electricity"

*"Heating"

*"Heat Pumps"

*"Refrigeration"

"Solar Heating Systems"

*"Welding, Phase A, Oxyacetylene"

*"Welding, Phase B, Shielded Metal Arc"

*Available from the Vocational Education Materials Center, University of Georgia, Athens, GA 30602

Prentice-Hall Media, filmstrips in metalworking

STUDENT MANUALS

Carrier Corporation: Syracuse, NY

- GTA Manuals (Air Conditioning)
- GTE Manuals (Electricity)
- GTH Manuals (Heating)
- GTR Manuals (Refrigeration)
- Solar Heating Basics

Copeland Corporation: Sidney, OH
The Copeland Corporation produces a series of refrigeration manuals, available from the Copeland Corporation.

- Copeland Electrical Handbook
- Fundamentals of Refrigeration
- Installation and Service
- Refrigeration System Components
- System Design
- The Refrigeration Load

Georgia Department of Education, Atlanta, GA: Office of Vocational Education

- *Air Conditioning, Post Secondary, 1980
- *Electricity, Post Secondary, 1980
- *Heating, Post Secondary, 1980
- *Heat Pumps, Post Secondary, 1980
- *Refrigeration, Post Secondary, 1980
- Solar Heating Systems Curriculum, 1979

*Welding, Phase A, Oxyacetylene, 1980

*Welding, Phase B, Shielded Metal Arc, 1980

*Available from the Vocational Education Materials Center, University of Georgia, Athens, GA 30602

Lennox Industries, Inc., Solar Application Course. Dallas, TX: Lennox Education Products, 1979.

ADDITIONAL INSTRUCTIONAL RESOURCES

Textbooks

AAVIM, *Developing Shop Safety Skills*. Athens, GA: American Association For Vocational Instructional Materials, 1978.

AAVIM, *Developing Shop Safety Skills: Instructor's Guide*. Athens, GA: American Association For Vocational Instructional Materials, 1978.

AAVIM, *Developing Shop Safety Skills: Student Workbook*. Athens, GA: American Association For Vocational Instructional Materials, 1978.

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AAVIM, *Maintaining The Lighting and Wiring System*. Athens, GA: American Association For Vocational Instructional Materials, 1974.

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Alerich, W. N., Electricity 3-DC Motors and Generators, Controls, Transformers. Albany, NY: Delmar Publications, 1980.

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Anderson, E. P., Home Appliance Servicing. Indianapolis, IN: Bobbs-Merrill Educational Publishing, 1974.

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California, Practical Wiring Part I. Sacramento, CA: California State Department of Education, Bureau of Industrial Education, 1974.

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National Radio Institute, Servicing Electrical Appliances: Vol. II, Motor Theory and Motor-Driven Items. New York, NY: Gregg/McGraw-Hill, 1972.

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Whirlpool, Range Service: Electric, Gas and Microwave Ovens. Benton Harbor, MI: Whirlpool Corp. Technical Information Center, 1977.

Whirlpool, Test Equipment: Selection, Care, Application. Benton Harbor, MI: Whirlpool Corp.

Audio Visuals

AAVIM	Slide/tape and transparencies
Bergwall Productions, Inc.	Filmstrips
Career Aids, Inc.	Filmstrip
Instructional Materials Laboratory	Transparencies
MAVCC	Transparencies
National Training Aids, Inc.	Slide set
Prentice-Hall Media	Filmstrip
Singer Care Systems	Filmstrip
Vocational-Technical Instructional Services	Transparencies
Westinghouse	Filmstrip
Whirlpool	Filmstrip

Additional audio visual resources are listed in Index to Vocational and Technical Education (Multimedia) and are available from:

National Information Center for Educational Media
(NICEM)
University of South California
University Park
Los Angeles, CA 90007

RESOURCE ADDRESSES

AAVIM
120 Engineering Center
Athens, GA 30602

American Tech
5608 Stony Island Avenue
Chicago, IL 60637

Bennett Publishing Company
809 W. Detweiller Drive
Department E 81
Peoria, IL 61615

Bergwall Productions, Inc.
839 Stewart Avenue
Garden City, NY 11530

Bobbs-Merrill Educational Publishing
Department No. 627
7300 West 62nd Street
P.O. Box 7080
Indianapolis, IN 46206

California State Department of Education
Bureau of Industrial Education
721 Capitol Mall
Sacramento, CA 95814

Career Aids, Inc.
8950 Lurline Avenue
Department T. 76
Chatsworth, CA 91311

Carrier Corporation
Carrier Parkway
Syracuse, NY 13221

Carrier Corporation
Mingledorff Company
P.O. Box 13031
Atlanta, GA 30321

Charles A. Bennett Company, Inc.
809 Detweiler Drive
Peoria, IL 61614

Clemson University
Clemson, SC 29631

Copeland: Copeland Corporation
Sidney, OH 45365

Delmar Publications
50 Wolf Road
Albany, NY 12205

Division of Vocational Education
Alabama State Department of Education
Link Education Laboratory
Montgomery, AL 36111

Doolco, Inc.
2016 Canton
Dallas, TX 75226

Duxbury Press
North Scituate, MA 02060

Georgia Office of Vocational Education
Georgia Department of Education
Atlanta, GA 30334

Goodheart-Willcox Company
123 W. Taft Drive
South Holland, IL 60473

Gregg/McGraw-Hill
P.O. Box 996
Norcross, GA 30091

Hobar Publications
1234 Tiller Lane
St. Paul, MN 55112

Instructional Materials Laboratory
10 Industrial Education Building
University of Missouri-Columbia
Columbia, MO 65221

Master Publications, Inc.
1660 Euclid Street
Santa Monica, CA 90404

MAVCC
1515 West Sixth Avenue
Stillwater, OK 74074

McKnight Publishing Company
Box 2854
Bloomington, IL 61707

Metalbestos Products
P.O. Box 137
Belmont, CA 94002

Mid-America Vocational
Curriculum Consortium
1515 West Sixth Avenue
Stillwater, OK 74074

National Fire Protection
Association
470 Atlantic Avenue
Boston, MA 02210

National Training Aids, Inc.
Manual Division "M"
P.O. Box 565
Norcross, GA 30091

New Hampshire Facilitator
Center
80 South Main Street
Concord, NH 03301

Office of Career and Adult
Education
State Department of Education
Jefferson City, MO 65101

Orange County Career
Development Program
410 Woods Avenue
Orlando, FL 32805

Prentice-Hall Media
Serv Code VD 3
150 White Plains Road
Tarrytown, NY 10591

Rutgers - The State University
Building 4103 - Kilmer Campus
New Brunswick, NJ 08903

Singer Career Systems
80 Commerce Drive
Rochester, NY 14623

(The) Superintendent of
Documents
United States Government
Printing Office
Washington, DC 20402

Vocational Education Materials
Center
Green Street
The University of Georgia
Athens, GA 30602

Vocational Instructional
Services
Texas A & M University
College Station, TX 77843

Vocational-Technical Curriculum
Laboratory
Rutgers - The State University
Building 4103 - Kilmer Campus
New Brunswick, NJ 08903

Westinghouse Learning
Corporation
100 Park Avenue
New York, NY 10017

Westinghouse Corporation
P.O. Box 4022
Elyria, OH 44036

Whirlpool Corporation
Service Training Department
Benton Harbor, MI 49022

Whirlpool Corporation
Technical Information Center
Benton Harbor, MI 49022

Wisconsin Vocational Studies
Center
University of Wisconsin -
Madison
964 Educational Services
Building
1025 West Johnson Street
Madison, WI 49002

SECTION VII

STUDENT RECORDS

STUDENT RECORDS

This section contains four forms, the Individual Progress Report Chart, the Group Progress Chart, the Competency Checklist and the Certificate of Competency. The use of these Charts is described below and on page 6.

INDIVIDUAL PROGRESS REPORT

One copy should be kept in each student's confidential file and updated as tasks are completed. Grades should be assigned upon task completion and then averaged for grade reporting. Difficulty, excessive amounts of time, etc. should be noted on this form and should be discussed with the student.

GROUP PROGRESS CHART

This chart reflects task completion only and can be displayed in the classroom or lab area. Due to confidentiality of records, a grade must not be recorded. The instructor should maintain a copy of this record and update it daily.

INDIVIDUAL PROGRESS REPORT

NAME ____________________

PROGRAM/ CLUSTER ____________________ AREA ____________________

TASK/ UNIT NO.	UNIT TITLE	DATE STARTED	DATE COMP.	EST. TIME	GRADE

GROUP PROGRESS CHART

NAME	UNITS/TASKS																				

COMPETENCY CHECKLIST

The Competency Checklist is an easy device for the instructor to use to know when a student is eligible to receive a Certificate of Competency (shown on page 9). One Checklist is used per student for as long as the student stays in the program. The instructor may use the checklist in the following manner:

1. Enter the student's name on the form.
2. As the student masters each task, check-off the task under each job title on the Competency Checklist for which it appears.
3. Keep the Checklist in each student's personal file or keep all Competency Checklists together in a separate file.
4. When all the tasks underneath a job title have been checked-off, the student is eligible to receive a Certificate of Competency for that job title.

CERTIFICATE OF COMPETENCY

The Certificate of Competency is issued by the instructor to certify that the student has mastered the tasks necessary for entry level employment for the job listed on the Certificate. The specific tasks that have been mastered are printed on the back of the Certificate, which can be used by the student to show a prospective employer exactly what the student is qualified to do. The Certificates should be printed ahead of time so that the instructor may simply fill in the front of the Certificate whenever a student is eligible to receive one, as indicated by the student's Competency Checklist. A sample completed Certificate of Competency appears on page 9 followed by a Certificate of Competency for each of the possible Heating, Refrigeration and Air Conditioning program exit points (job titles).

The Certificate should be completed by the instructor as follows:

1. Enter the student's name.
2. Enter the school name.
3. Date and sign the Certificate.
4. It is recommended that the Certificate be stamped with the school seal.

COMPETENCY CHECKLIST

____
Student Name

As the student masters each unit of instruction, check off the unit number under each of the following job titles where it appears. When all the units under a job title have been completed, the student is eligible to receive a Certificate of Competency for that job title.

REFRIGERATION MECHANIC
637.261-026

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REFRIGERATION UNIT REPAIRER
637.381-014

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AIR CONDITIONING INSTALLER
827.464-010

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WINDOW A/C INSTALLER-SERVICER
637.261-010

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ENVIRONMENTAL CONTROL SYSTEM INSTALLER-SERVICER HELPER 637.664-010

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ENVIRONMENTAL CONTROL
SYSTEM INSTALLER-SERVICER
637.261-014

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HOT AIR FURNACE
INSTALLER-REPAIRER
869.281-010

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CERTIFICATE OF COMPETENCY

This is to Certify that

Chuck Mashburn

of

SAMPLE

Augusta Area Technical School

has successfully mastered the competencies required to perform the job of

AIR CONDITIONING INSTALLER

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Air Conditioning Installer.

AIR CONDITIONING INSTALLER
827.464-010

ELECTRICITY FUNDAMENTALS

Using basic electrical theory
Computing Ohm's law and power formulas
Using electric meters
Understanding series and parallel circuits
Identifying electric symbols
Reading basic schematic diagrams
Reading advanced schematic diagrams
Applying alternating current principles
Determining and selecting wire size and making connections
Making main panel connections

AIR CONDITIONING FUNDAMENTALS

Servicing air filtering systems

WINDOW AIR CONDITIONING

Installing a window air conditioning unit
Troubleshooting window air conditioner electrical system

SYSTEM INSTALLATION

Installing condensate drains
Installing residential and mobile home package air conditioning units
Installing split system air conditioning units
Installing add-on split air conditioning systems

TROUBLESHOOTING AND SERVICING

Troubleshooting compressor burnout
Troubleshooting fans and fan motors
Performing pre-season start up air conditioning service
Troubleshooting air conditioner refrigeration cycle
Troubleshooting air conditioner electrical cycle
Troubleshooting air conditioner air movement

HEAT PUMPS

Applying principles of the heat pump
Evacuating and charging the heat pump
Installing a reversing valve
Installing electrical circuits
Installing package heat pumps
Installing split-system heat pumps

SHEET METAL

Identifying materials used in sheet metalwork
Developing sheet metal patterns (stretchouts)
Cutting sheet metal
Bending sheet metal by hand
Bending metal on a bar folder or brake
Roll-forming sheet metal
Making seams
Using the rotary machine
Fastening sheet metal
Cutting and welding sheet metal using oxyacetylene equipment
Welding sheet metal using metal arc welding equipment
Soldering sheet metal

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of

Refrigeration Mechanic

____

____

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Refrigeration Mechanic.

REFRIGERATION MECHANIC
637.261-026

ELECTRICITY FUNDAMENTALS

Using basic electrical theory
Computing Ohm's law and power formulas
Using electric meters
Understanding series and parallel circuits
Identifying electrical symbols
Reading basic schematic diagrams
Reading advanced schematic diagrams
Applying alternating current principles
Determining and selecting wire size and making connections
Making main panel connections

ELECTRIC MOTORS

Servicing shaded pole motors
Wiring split-phase motors
Checking capacitors
Hooking up and troubleshooting PSC motors
Hooking up and troubleshooting CS motors
Hooking up and troubleshooting CSR motors
Connecting three phase motors
Testing motors
Maintaining electric motors

ELECTRICAL COMPONENTS

Installing and testing transformers
Installing and testing contractors and relays
Installing and checking thermostats
Installing and checking pressure switches
Troubleshooting overload devices
Installing and checking various electric control devices
Troubleshooting magnetic starters

CONTROLS AND INSTALLATION

Wiring packaged air conditioners
Wiring split system air conditioning units
Designing a control panel
Designing an advanced control panel
Troubleshooting a basic electrical control system
Advanced troubleshooting of electrical control systems
Servicing solid-state control circuits

REFRIGERATION FUNDAMENTALS

Becoming familiar with career opportunities in refrigeration
Identifying safe working conditions
Demonstrating a knowledge of the basic refrigeration concepts
Demonstrating knowledge of the basic refrigeration cycle
Using refrigeration tools
Tapping, threading and replacing threads

TUBING AND PIPE

Becoming familiar with fitting nomenclature and pipe materials
Performing basic copper tubing operations
Soft soldering copper tubing
Silver brazing

REFRIGERANTS

Handling refrigerants
Installing and using access valves
Maintaining refrigeration manifold gauges
Installing and using refrigeration manifold gauges
Evacuating a refrigeration system
Installing refrigeration accessories
Testing for leaks
Charging the system

TROUBLESHOOTING

Testing the compressor
Troubleshooting condensers
Troubleshooting evaporators
Troubleshooting an automatic expansion valve
Troubleshooting capillary tubes
Troubleshooting thermostatic expansion valves
Troubleshooting the refrigeration system

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of

Refrigeration Unit Repairer

____

____

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Refrigeration Unit Repairer.

REFRIGERATION UNIT REPAIRER
637.381-014

ELECTRICITY FUNDAMENTALS

Using basic electrical theory
Computing Ohm's law and power formulas
Using electric meters
Understanding series and parallel circuits
Identifying electrical symbols
Reading basic schematic diagrams
Reading advanced schematic diagrams
Applying alternating current principles
Determining and selecting wire size and making connections
Making main panel connections

ELECTRIC MOTORS

Servicing shaded pole motors
Wiring split-phase motors
Checking capacitors
Hooking up and troubleshooting PSC motors
Hooking up and troubleshooting CS motors
Hooking up and troubleshooting CSR motors
Connecting three phase motors
Testing motors
Maintaining electric motors

ELECTRICAL COMPONENTS

Installing and testing transformers
Installing and testing contractors and relays
Installing and checking thermostats
Installing and checking pressure switches
Troubleshooting overload devices
Installing and checking various electric control devices
Troubleshooting magnetic starters

CONTROLS AND INSTALLATION

Wiring packaged air conditioners
Wiring split system air conditioning units
Designing a control panel
Designing an advanced control panel
Troubleshooting a basic electrical control system
Advanced troubleshooting of electrical control systems
Servicing solid-state control circuits

REFRIGERATION FUNDAMENTALS

Becoming familiar with career opportunities in refrigeration
Identifying safe working conditions
Demonstrating a knowledge of the basic refrigeration concepts
Demonstrating knowledge of the basic refrigeration cycle
Using refrigeration tools
Tapping, threading and replacing threads

TUBING AND PIPE

Becoming familiar with fitting nomenclature and pipe materials
Performing basic copper tubing operations
Soft soldering copper tubing
Silver brazing

REFRIGERANTS

Handling refrigerants
Installing and using access valves
Maintaining refrigeration manifold gauges
Installing and using refrigeration manifold gauges
Evacuating a refrigeration system
Installing refrigeration accessories
Testing for leaks
Charging the system

TROUBLESHOOTING

Testing the compressor
Troubleshooting condensers
Troubleshooting evaporators
Troubleshooting an automatic expansion valve
Troubleshooting capillary tubes
Troubleshooting thermostatic expansion valves
Troubleshooting the refrigeration system

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of

Air Conditioning Installer

____

____

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Air Conditioning Installer.

AIR CONDITIONING INSTALLER
827.464-010

ELECTRICITY FUNDAMENTALS

Using basic electrical theory
Computing Ohm's law and power formulas
Using electric meters
Understanding series and parallel circuits
Identifying electric symbols
Reading basic schematic diagrams
Reading advanced schematic diagrams
Applying alternating current principles
Determining and selecting wire size and making connections
Making main panel connections

AIR CONDITIONING FUNDAMENTALS

Servicing air filtering systems

WINDOW AIR CONDITIONING

Installing a window air conditioning unit
Troubleshooting window air conditioner electrical system

SYSTEM INSTALLATION

Installing condensate drains
Installing residential and mobile home package air conditioning units
Installing split system air conditioning units
Installing add-on split air conditioning systems

TROUBLESHOOTING AND SERVICING

Troubleshooting compressor burnout
Troubleshooting fans and fan motors
Performing pre-season start up air conditioning service
Troubleshooting air conditioner refrigeration cycle
Troubleshooting air conditioner electrical cycle
Troubleshooting air conditioner air movement

HEAT PUMPS

Applying principles of the heat pump
Evacuating and charging the heat pump
Installing a reversing valve
Installing electrical circuits
Installing package heat pumps
Installing split-system heat pumps

SHEET METAL

Identifying materials used in sheet metalwork
Developing sheet metal patterns (stretchouts)
Cutting sheet metal
Bending sheet metal by hand
Bending metal on a bar folder or brake
Roll-forming sheet metal
Making seams
Using the rotary machine
Fastening sheet metal
Cutting and welding sheet metal using oxyacetylene equipment
Welding sheet metal using metal arc welding equipment
Soldering sheet metal

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of

Window Air Conditioning Installer-Servicer

____

____

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Window Air Conditioning Installer-Servicer.

WINDOW AIR CONDITIONING INSTALLER-SERVICER
637.261-010

ELECTRICITY FUNDAMENTALS

- Using basic electrical theory
- Computing Ohm's law and power formulas
- Using electric meters
- Understanding series and parallel circuits
- Identifying electric symbols
- Reading basic schematic diagrams
- Reading advanced schematic diagrams
- Applying alternating current principles
- Determining and selecting wire size and making connections
- Making main panel connections

ELECTRIC MOTORS

- Servicing shaded pole motors
- Wiring split-phase motors
- Checking capacitors
- Hooking up and troubleshooting PSC motors
- Hooking up and troubleshooting CS motors
- Hooking up and troubleshooting CSR motors
- Connecting three phase motors
- Testing motors
- Maintaining electric motors

ELECTRICAL COMPONENTS

- Installing and testing transformers
- Installing and testing contractors and relays
- Installing and checking thermostats
- Installing and checking pressure switches
- Troubleshooting overload devices
- Installing and checking various electric control devices
- Troubleshooting magnetic starters

CONTROLS AND INSTALLATION

- Wiring packaged air conditioners
- Wiring split system air conditioning units
- Designing a control panel
- Designing an advanced control panel
- Troubleshooting a basic electrical control system
- Advanced troubleshooting of electrical control system
- Servicing solid-state control circuits

REFRIGERATION FUNDAMENTALS

- Becoming familiar with career opportunities in refrigeration
- Identifying safe working conditions
- Demonstrating a knowledge of the basic refrigeration concepts
- Demonstrating a knowledge of the basic refrigeration concepts
- Demonstrating knowledge of the basic refrigeration cycle
- Using refrigeration tools
- Tapping, threading and replacing threads

TUBING AND PIPE

- Becoming familiar with fitting nomenclature and pipe materials
- Performing basic copper tubing operations
- Soft soldering copper tubing
- Silver brazing

REFRIGERANTS

- Handling refrigerants
- Installing and using access valves
- Maintaining refrigeration manifold gauges
- Installing and using refrigeration manifold gauges
- Evacuating a refrigeration system
- Installing refrigeration accessories
- Testing for leaks
- Charging the system

TROUBLESHOOTING

- Testing the compressor
- Troubleshooting condensers
- Troubleshooting evaporators
- Troubleshooting an automatic expansion valve
- Troubleshooting capillary tubes
- Troubleshooting thermostatic expansion valves
- Troubleshooting the refrigeration system

AIR CONDITIONING FUNDAMENTALS

- Identifying major components and functions of air conditioning systems
- Applying basic air principles
- Calculating heat loads
- Applying principles of air movement
- Servicing air filtering systems

WINDOW AIR CONDITIONING

- Installing a window air conditioning unit
- Performing pre-season start up maintenance on window air conditioning units
- Troubleshooting compressor burnout in window air conditioners
- Evacuating and charging window air conditioners
- Troubleshooting fans and fan motors
- Troubleshooting mechanical problems in window air conditioner refrigeration cycle
- Troubleshooting a window air conditioner electrical system

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of

Environmental Control System Installer-Servicer Helper

____

____

____

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Environmental Control System Installer-Servicer Helper.

ENVIRONMENTAL CONTROL SYSTEM INSTALLER-SERVICER HELPER

637.664-010

ELECTRICITY FUNDAMENTALS

Using basic electrical theory
Computing Ohm's law and power formulas
Using electric meters
Understanding series and parallel circuits
Identifying electric symbols
Reading basic schematic diagrams
Applying alternating current principles
Determining and selecting wire size and making connections
Making main panel connections

REFRIGERATION FUNDAMENTALS

Becoming familiar with career opportunities in refrigeration
Identifying safe working conditions
Demonstrating a knowledge of the basic refrigeration concepts
Demonstrating knowledge of the basic refrigeration cycle
Using refrigeration tools
Tapping, threading and replacing threads

TUBING AND PIPE

Becoming familiar with fitting nomenclature and pipe materials
Performing basic copper tubing operations
Soft soldering copper tubing
Silver brazing

REFRIGERANTS

Handling refrigerants
Installing and using access valves
Maintaining refrigeration manifold gauges
Evacuating a refrigeration system
Installing refrigeration accessories
Testing for leaks
Charging the system

AIR CONDITIONING FUNDAMENTALS

Identifying major components and functions of air conditioning systems
Applying basic air principles
Applying principles of air movement
Servicing air filtering systems

WINDOW AIR CONDITIONING

Installing a window air conditioning unit
Performing pre-season start up maintenance on window air conditioning units
Evacuating and charging window air conditioners

SYSTEM INSTALLATION

Installing condensate drains
Installing residential and mobile home package air conditioning units
Installing split system air conditioning units
Installing add-on split air conditioning systems

TROUBLESHOOTING AND SERVICING

Performing pre-season start up air conditioning service

HEAT PUMPS

Applying principles of the heat pump
Evacuating and charging the heat pump
Installing package heat pumps
Installing split-system heat pumps

ELECTRIC HEATING SYSTEMS

Applying principles of electric furnaces and controls
Installing electric furnaces

GAS HEATING SYSTEMS

Applying gas fuel combustion and safety principles
Identifying major components and functions of gas heating systems
Checking gas sources
Applying gas piping principles
Venting gas heating systems

OIL BURNING SYSTEMS

Designing and installing oil piping

SHEET METAL

Identifying materials used in sheet metalwork
Developing sheet metal patterns (stretch-outs)
Cutting sheet metal
Bending sheet metal by hand
Bending metal on a bar folder or brake
Roll-forming sheet metal
Making seams
Using the rotary machine
Fastening sheet metal
Cutting and welding sheet metal using oxyacetylene equipment
Welding sheet metal using metal arc welding equipment
Soldering sheet metal

PRINCIPLES OF SOLAR ENERGY

Demonstrating knowledge of the basic principles of solar energy and solar radiation
Identifying basic solar system components and their uses

SOLAR SYSTEM DESIGN

Conducting an energy audit of a residence
Selecting passive solar approaches for new construction
Selecting solar collectors
Selecting and siting thermal storage units
Selecting control devices
Identifying and describing modes of solar system operation
Calculating heat load for space or domestic hot water heating
Sizing solar system components
Performing a solar system economic analysis
Selecting a domestic solar hot water system

SOLAR INSTALLATION

Selecting/fabricating correct thermal mass for a direct gain solar system
Integrating installation of a solar system in a construction schedule
Installing liquid storage tanks
Siting and mounting collectors
Installing liquid collectors and outside plumbing
Installing inside plumbing for collector load-side loops
Installing controls and wiring
Filling and starting the system

SOLAR MAINTENANCE

Maintaining a solar system
Troubleshooting solar system problems

CERTIFICATE OF COMPETENCY

This is to Certify that

____

of

____

has successfully mastered the competencies required to perform the job of

Environmental Control System Installer-Servicer

____

____

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Environmental Control System Installer-Servicer.

ENVIRONMENTAL CONTROL SYSTEM INSTALLER-SERVICER
637.361-01

ELECTRICITY FUNDAMENTALS

- Using basic electrical theory
- Computing Ohm's law and power formula
- Using electric meters
- Understanding series and parallel circuits
- Identifying electric symbols
- Reading basic schematic diagrams
- Reading advanced schematic diagrams
- Applying alternating current principles
- Determining and selecting wire size and making connections
- Making main panel connections

ELECTRIC MOTORS

- Servicing shaded pole motors
- Wiring split-phase motors
- Checking capacitors
- Hooking up and troubleshooting PSC motors
- Hooking up and troubleshooting CS motors
- Hooking up and troubleshooting CSR motors
- Connecting three phase motors
- Testing motors
- Maintaining electric motors

ELECTRICAL COMPONENTS

- Installing and testing transformers
- Installing and testing contractors and relays
- Installing and checking thermostats
- Installing and checking pressure switches
- Troubleshooting overload devices
- Installing and checking various electric control devices
- Troubleshooting magnetic starters

TROUBLESHOOTING

- Testing the compressor
- Troubleshooting condensers
- Troubleshooting evaporators
- Troubleshooting an automatic expansion valve
- Troubleshooting capillary tubes
- Troubleshooting thermostatic expansion valves
- Troubleshooting the refrigeration system

AIR CONDITIONING FUNDAMENTALS

- Identifying major components and functions of air conditioning systems
- Applying basic air principles
- Calculating head loads
- Applying principles of air movement
- Servicing air filtering systems

WINDOW AIR CONDITIONING

- Installing a window air conditioning unit
- Performing pre-season start up maintenance on window air conditioning units
- Troubleshooting compressor burnout in window air conditioners
- Evacuating and charging window air conditioners
- Troubleshooting fans and fan motors
- Troubleshooting mechanical problems in window air conditioner refrigeration cycle
- Troubleshooting a window air conditioner electrical system

SYSTEM INSTALLATION

- Installing condensate drains
- Installing residential and mobile home package air conditioning units
- Installing split system air conditioning units
- Installing add-on split air conditioning systems
- Servicing gas furnace electrical controls
- Determining combustion efficiency
- Performing a pre-season check-up and start-up on a gas furnace
- Troubleshooting the gas heating system

OIL BURNING SYSTEMS

- Identifying types of fuel oil and principles of combustion
- Designing and installing oil piping
- Installing oil burners
- Installing and servicing transformers and electrodes
- Installing oil pumps
- Servicing blower, nozzle, motor and coupling
- Performing the combustion efficiency test
- Installing controls
- Performing pre-season start-up and check-up on an oil burning heating system
- Troubleshooting the oil burning heating system

SHEET METAL

- Identifying materials used in sheet metal-work
- Developing sheet metal patterns (stretch-outs)
- Cutting sheet metal
- Bending sheet metal by hand
- Bending metal on a bar folder or brake
- Roll-forming sheet metal
- Making seams
- Using the rotary machine
- Fastening sheet metal
- Cutting and welding sheet metal using oxyacetylene equipment
- Welding sheet metal using metal arc welding equipment
- Soldering sheet metal

CONTROLS AND INSTALLATION

- Wiring packaged air conditioners
- Wiring split system air conditioning units
- Designing a control panel
- Designing an advanced control panel
- Troubleshooting a basic electrical control system
- Advanced troubleshooting of electrical control systems
- Servicing solid-state control circuits

REFRIGERATION FUNDAMENTALS

- Becoming familiar with career opportunities in refrigeration
- Identifying safe working conditions
- Demonstrating a knowledge of the basic refrigeration concepts
- Demonstrating knowledge of the basic refrigeration cycle
- Using refrigeration tools
- Tapping, threading and replacing threads

TUBING AND PIPE

- Becoming familiar with fitting nomenclature and pipe materials
- Performing basic copper tubing operations
- Soft soldering copper tubing
- Silver brazing

REFRIGERANTS

- Handling refrigerants
- Installing and using access valves
- Maintaining refrigeration manifold gauges
- Evacuating a refrigeration system
- Installing refrigeration accessories
- Testing for leaks
- Charging the system

TROUBLESHOOTING AND SERVICING

- Troubleshooting compressor burnout
- Troubleshooting fans and fan motors
- Performing pre-season start up air conditioning service
- Troubleshooting air conditioner refrigeration cycle
- Troubleshooting air conditioner electrical cycle
- Troubleshooting air conditioner air movement

HEAT PUMPS

- Applying principles of the heat pump
- Evacuating and charging the heat pump
- Installing a reversing valve
- Tracing the heat pump refrigeration cycle
- Installing electrical circuits
- Adjusting and repairing defrost controls
- Installing package heat pumps
- Installing split-system heat pumps

ELECTRIC HEATING SYSTEMS

- Applying principles of electric furnaces and controls
- Installing electric furnaces
- Troubleshooting electric furnaces

GAS HEATING SYSTEMS

- Applying gas fuel combustion and safety principles
- Identifying major components and functions of gas heating systems
- Checking gas sources
- Applying gas piping principles
- Installing and adjusting gas regulators
- Installing and servicing gas valves
- Installing and servicing pilot ignition devices
- Installing and servicing combination gas valves
- Servicing gas burners
- Inspecting and adjusting temperature rise of heat exchangers
- Venting gas heating systems

PRINCIPLES OF SOLAR ENERGY

- Demonstrating knowledge of the basic principles of solar energy and solar radiation
- Identifying basic solar system components and their uses

SOLAR SYSTEM DESIGN

- Conducting an energy audit of a residence
- Selecting passive solar approaches for new construction
- Selecting solar collectors
- Selecting and siting thermal storage units
- Selecting control devices
- Identifying and describing modes of solar system operation
- Calculating heat load for space or domestic hot water heating
- Sizing solar system components
- Performing a solar system economic analysis
- Selecting a domestic solar hot water system

SOLAR INSTALLATION

- Selecting/fabricating correct thermal mass for a direct gain solar system
- Integrating installation of a solar system in a construction schedule
- Installing liquid storage tanks
- Siting and mounting collectors
- Installing liquid collectors and outside plumbing
- Installing inside plumbing for collector load-size loops
- Installing controls and wiring
- Filling and starting the system

SOLAR MAINTENANCE

- Maintaining a solar system
- Troubleshooting solar system problems

CERTIFICATE OF COMPETENCY

This is to Certify that

of

has successfully mastered the competencies required to perform the job of

Hot Air Furnace Installer and Repairer

The student named on this certificate has demonstrated mastery of the following tasks required to perform the job of Hot Air Furnace Installer and Repairer.

HOT AIR FURNACE INSTALLER AND REPAIRER
869.281-

ELECTRICITY FUNDAMENTALS

Using basic electrical theory
Computing Ohm's law and power formulas
Using electric meters
Understanding series and parallel circuits
Identifying electric symbols
Reading basic schematic diagrams
Reading advanced schematic diagrams
Applying alternating current principles
Determining and selecting wire size and making connections
Making main panel connections

ELECTRIC MOTORS

Servicing shaded pole motors
Wiring split-phase motors
Checking capacitors
Hooking up and troubleshooting PSC motors
Hooking up and troubleshooting CS motors
Hooking up and troubleshooting CSR motors
Connecting three phase motors
Testing motors
Maintaining electric motors

ELECTRICAL COMPONENTS

Installing and testing transformers
Installing and testing contractors and relays
Installing and checking thermostats
Installing and checking pressure switches
Troubleshooting overload devices
Installing and checking various electric control devices
Troubleshooting magnetic starters

CONTROLS AND INSTALLATION

Designing a control panel
Designing an advanced control panel
Troubleshooting a basic electrical control system
Advanced troubleshooting of electrical control systems
Servicing solid-state control circuits

ELECTRIC HEATING SYSTEMS

Applying principles of electric furnaces and controls
Installing electric furnaces
Troubleshooting electric furnaces

GAS HEATING SYSTEMS

Applying gas fuel combustion and safety principles
Identifying major components and functions of gas heating systems
Checking gas sources
Applying gas piping principles
Installing and adjusting gas regulators
Installing and servicing gas valves
Installing and servicing pilot ignition devices
Installing and servicing combination gas valves
Servicing gas burners
Inspecting and adjusting temperature rise of heat exchangers
Venting gas heating systems
Servicing gas furnace electrical controls
Determining combustion efficiency
Performing a pre-season check-up and start-up on a gas furnace
Troubleshooting the gas heating system

OIL BURNING SYSTEMS

Identifying types of fuel oil and principles of combustion
Designing and installing oil piping
Installing oil burners
Installing and servicing transformers and electrodes
Installing oil pumps
Servicing blower, nozzle, motor and coupling
Performing the combustion efficiency test
Installing controls
Performing pre-season start-up and check-up on an oil burning heating system
Troubleshooting the oil burning heating system

SHEET METAL

Identifying materials used in sheet metalwork
Developing sheet metal patterns (stretchouts)
Cutting sheet metal
Bending sheet metal by hand
Bending metal on a bar folder or brake
Roll-forming sheet metal
Making seams
Using the rotary machine
Fastening sheet metal
Cutting and welding sheet metal using oxyacetylene equipment
Welding sheet metal using metal arc welding equipment
Soldering sheet metal

SECTION VIII

SPECIAL NEEDS STUDENT

WORKING WITH SPECIAL NEEDS STUDENTS

Introduction

Special needs students are those who are designated as handicapped and/or disadvantaged. The 1976 vocational education amendment defines handicapped individuals as:

> Persons who are mentally retarded, hard of hearing, deaf, speech impaired, visually handicapped, seriously emotionally disturbed, orthopedically impaired, health impaired, or persons with other specific disabilities, who by reason thereof require special education and related services and who cannot succeed in the regular vocational education programs.

In Title II of the 1976 education amendments disadvantaged persons are defined as:

> Persons (other than handicapped persons) who have academic or economic disadvantages and who require special services, assistance or programs in order to enable them to succeed in vocational education programs.

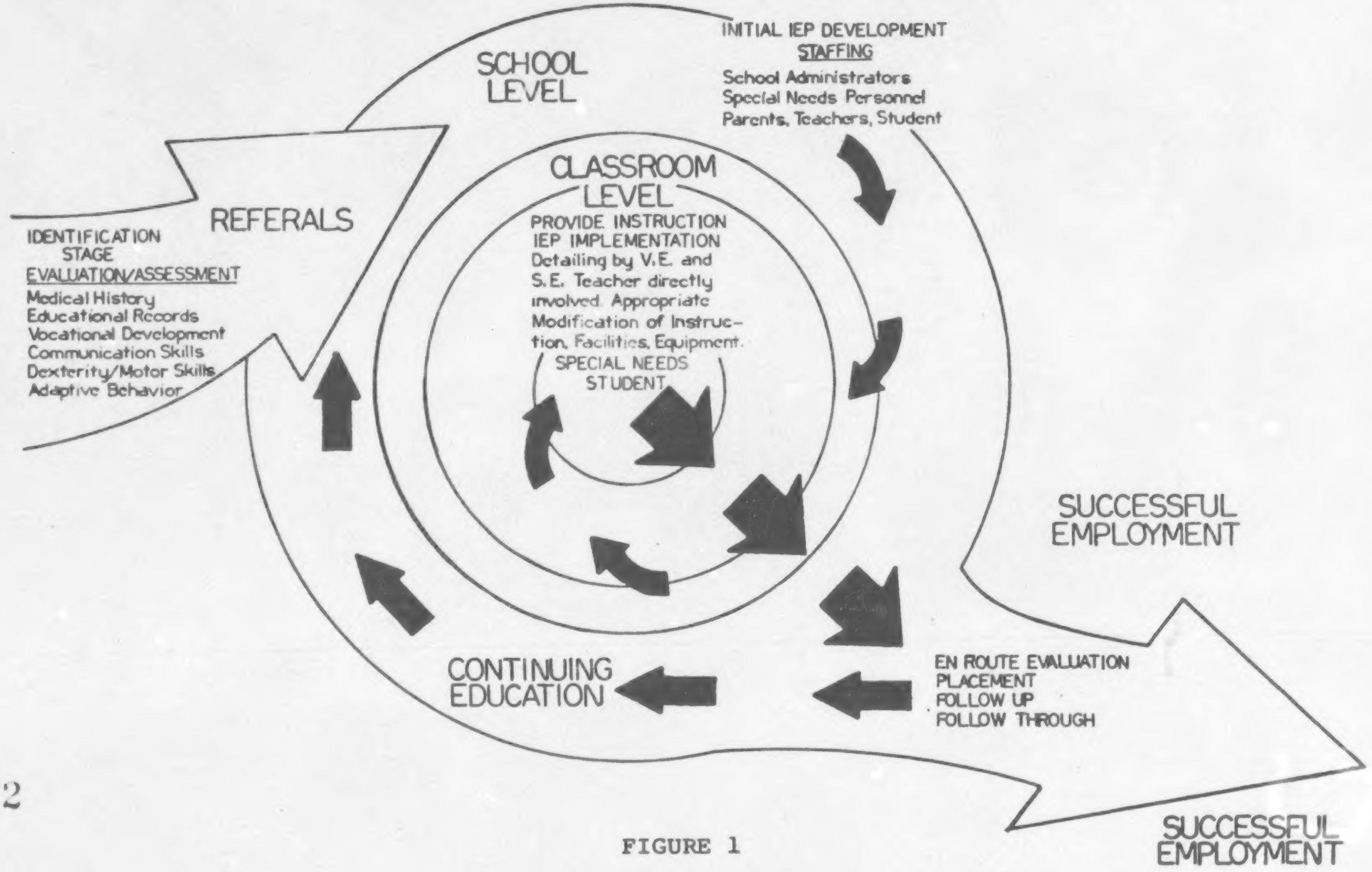
Federal legislation requires that these special people be given an opportunity to function in a regular classroom. This section provides information on how special needs students are identified and how they can be mainstreamed into regular educational environments.

Figure One presents a model depicting various activities of the process in identifying and mainstreaming special needs students. These activities are conducted at three levels: the system level, the school level and the classroom level. All three levels must work together if implementation of the process is to be effective.

Identification Of The Special Needs Student

Through a variety of pre-testing procedures, special needs students are identified and their potentials are evaluated at the

SPECIAL NEEDS MAINSTREAMING MODEL



SCHOOL LEVEL
INITIAL IEP DEVELOPMENT
STAFFING
School Administrators
Special Needs Personnel
Parents, Teachers, Student
REFERALS
IDENTIFICATION STAGE
EVALUATION/ASSESSMENT
Medical History
Educational Records
Vocational Development
Communication Skills
Dexterity/Motor Skills
Adaptive Behavior
CLASSROOM LEVEL
PROVIDE INSTRUCTION
IEP IMPLEMENTATION
Detailing by V.E. and S.E. Teacher directly involved. Appropriate Modification of Instruction, Facilities, Equipment.
SPECIAL NEEDS STUDENT
SUCCESSFUL EMPLOYMENT
CONTINUING EDUCATION
EN ROUTE EVALUATION
PLACEMENT
FOLLOW UP
FOLLOW THROUGH
SUCCESSFUL EMPLOYMENT

FIGURE 1

system level. This evaluation process consists of collecting and assessing the following data for each student:

- -Medical History
- -Educational Records
- -Vocational Development
- -Communication Skills
- -Dexterity/Motor Skills
- -Adaptive Behavior

When this procedure has been completed, the system personnel refers the student to the appropriate school level personnel.

Development of the Plan

At the school level, an Individual Education Plan (IEP) is developed for each special needs student. An IEP is a written plan which describes the educational objectives, both long and short term, and the support services for a special needs student. The plan is developed by the school administration, special education personnel, teacher(s) directly involved with the student and the parent(s). In some cases, the student may help with the development.

Implementing the I.E.P.

The actual implementing of the I.E.P. begins at the classroom level. The purpose of the teacher dealing with the special needs student is to help the student set realistic goals, identify the barriers which make it difficult for the student to learn and adapt the curriculum and/or facilities with reference to the I.E.P. so the student can learn while overcoming personal barriers.

Special needs students have problems which hinder their learning. Therefore, a teacher's job becomes more complicated than when teaching "regular" students. Handicapped students may have a variety of problems - mental, physical and/or emotional.

Academically disadvantaged students may exhibit language deficiencies, reading and writing deficiencies, computational deficiencies and general educational deficiencies. Economically disadvantaged students may possess an inability to concentrate because their primary needs - food, shelter, clothing - are not adequately met due to lack of money.

By considering these problems, teachers can modify existing programs to accommodate the needs of special needs learners. Some suggestions which may prove beneficial in modifying an existing curriculum are listed below:

-Prepare instructional materials in greater detail and assign work in shorter units.

-Provide more frequent evaluation of student's progress and provide opportunities for remedial work.

-Be aware of the student's limited vocabulary.

-Be aware of the student's inability to understand abstractions and generalizations and prepare materials accordingly.

-Keep the student aware of his or her progress and make the student feel he or she can succeed.

-Use real teaching aids, live work and practical experiences whenever possible.

-Choose reading material which is at the student's level, interest and experience.

-Use constructive criticism only.

-Use peer instruction whenever possible.

-Allow the student to advance at his or her own pace.

-Use the part-to-whole learning concept in adapting materials.

Facility Modifications

In some cases, facilities, must be modified for handicapped special needs students. In general, as long as the classroom/

shop meets federal guidelines for barrier free design, extensive facility changes need not be made. For visually impaired students, for example, let the student locate in the classroom where he or she can see best even to the point of moving the desk or work station as a portable unit. In the case of orthopedically handicapped, some changes may have to be made to shop machinery to allow the student to use it. This may involve more convenient controls or special seating where the student would normally stand. In making these changes, special education expertise would be helpful.

Evaluation

Evaluation of the student's program should consist of:

- En-route evaluation (formative) to monitor the student's progress through the program.
- Summative evaluation upon completion of the program to determine job readiness.
- Follow-up after placement to determine if the student is successful on the job.
- Follow-through activities designed to identify any further training needed, which is indicated by the follow-up procedure.

Working with special needs students is much more demanding of the system, the school and the instructor. However, with their patience and understanding, special needs student can not only succeed, but in many cases excell.

RESOURCES

To aid the teacher in modifying materials for special needs categories, the following references are listed by category. These are suggested references only as a world of materials exist on this subject.

Mentally Retarded

A Curriculum Guide for Teachers of Educable Mentally Retarded. Danville, Ill.: The Interstate Printers and Publishing Co., Inc.

High, Elizabeth C., and Moyers, Kathy L. Training Manual: Developing Pre-Vocational/Vocational Skills in Developmentally Disabled Persons. Washington, D.C.: Job Development Laboratory, George Washington University, 1976.

Kolstoe, Oliver P. Teaching Educable Mentally Retarded Children. Holt, Rinehart and Winston, 1976.

Mulligan, Robert E.; Gavin, Donald and Conaley, James. Comprehensive Career Education Curriculum Guide for the Trainable. New Brunswick, N.J.: Rutgers Vocational-Technical Curriculum Laboratory, 1977.

Introduction to Vocations for Educable Mentally Retarded. New Jersey: New Jersey Department of Education.

State of Ohio Curriculum Guide for Moderately Retarded Learners. Columbus, Ohio: Ohio Department of Education, 1977.

Tucker, Mark M. Learning through Curriculum Modification; A Blueprint to Teaching the Mentally Retarded. Johnstown, PA.: Mafex Associates, Inc., 1976.

Watson, Marjorie. Mainstreaming the Educable Mentally Retarded. Washington, D.C., NEA, 1975.

Hearing Impaired

Alvin, Howard P. The Evolution of an Evaluation Design for Evaluating Secondary Programs for the Deaf in Vocational Occupational-Technical Education (VOTE) Programs. ERIC - ED 123-241.

Guidelines: Educational Planning for the Hearing Handicapped. North Carolina Public Schools. Division for Exceptional Children, North Carolina Department of Public Instruction, Raleigh, N.C., 1977.

Munson, Harold L., Eglston, Judy Cobb and Phillips, Gordon B. *Career Education for Deaf Students: An Inservice Leader's Guide*. University of Rochester, College of Education, Center for the Study of Helping Services, Rochester, N.Y. 1975.

Nix, Gary W. *Mainstreaming Education for Hearing Impaired Children and Youth*. Grune and Stratton, 1976.

Orthopedically and Other Health

A Model Plan for a Cooperative Vocational Rehabilitation Program. Office of Human Development, Rehabilitation Services and Administration. Department of Health, Education and Welfare, Washington, D.C.

Mallix, Kalisanker and Mueller, Jim. *Vocational Aids and Enhanced Productivity of the Severely Disabled*. The George Washington University Rehabilitation Research and Training Center, Washington, D.C. 1975.

McCarthy, Henry and Smart, Landon. *Recommendations for Enhancing Employment Prospects of Handicapped Individuals*. Comps. Human Resources Center, Albertson, L. I., 1978.

Duncan, John, et al. *Environmental Modifications for the Visually Impaired: A Handbook*. Visual Impairment and Blindness, December 1977, p. 442-455.

Disadvantaged

Guidelines for Methods and Techniques of Teaching Disadvantaged Students. Division of Vocational Education, Virginia Polytechnic Institute and State University, Blackburg, VA.

A Handbook for Developing Programs and Services for Disadvantaged Students. Department of Vocational Education Studies, College of Education, Southern Illinois, University of Carbondale, Carbondale, Ill. 62901

By Program

Adaption of Home Economics Curricula for Special Needs. North Dakota Research Coordination Unit, State Board for Vocational Education, State Office Building, Bismarck, ND.

Auto Body: An Adaptive and Developmental Program for Special Needs Students. Vocational-Technical Curriculum Laboratory, Rutgers - The State University, New Brunswick, N.J. 1976.

Floriculture Board of Cooperative Educational Services of Nassaw County, Division of Occupational Education, Division of Special Education, Westburg, NY 1975.

Grubb, Francine. *Basic Business* - A Teacher's Guide to an Employment Orientation Course for Special Needs Students. Vocational Technical Curriculum Laboratory, Rutgers - The State University, New Brunswick, N.J. 1976.

Home Economics and the Exceptional Student: A Handbook for Home Economics Teachers Working with Mentally Retarded Students. Vocational-Technical Curriculum Laboratory, Rutgers - The State University, New Brunswick, N.J. 1976.

Troutman, Carol M. *Introduction to Office Occupations*. Vocational-Technical Curriculum Laboratory, Rutgers - The State University, New Brunswick, N.J. 1974.

Working with the Handicapped in the Vocational Home Economics Classroom. Division of Vocational Education, State of Ohio, Columbus, Ohio.

Coordinated Vocational Education and Training (C.V.E.T.) manuals for disadvantaged, available from: Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1515 West Sixth Avenue, Stillwater, Oklahoma 74074.

-CVET Construction	3100219	Teacher's Guide
	3100209	Student
-CVET General Mechanics	3100239	Teacher's Guide
	3100229	Student

General Special Needs

A Handbook for Modifying Vocational Curricula for Handicapped Students. Wisconsin Vocational Studies Center, University of Wisconsin, Madison, May 1980.

Bottoms, J.E. and Scott, C.P. Supportive services for special student groups. In J.E. Wall (ed.), *Vocational Education for Special Groups*. Sixth Yearbook, Washington, D.C.: American Vocational Association, 1976.

Gill, Douglas H. and Scott, C. Paul. A practical model for mainstreaming handicapped learners in vocational education. *The Journal for Vocational Special Needs Education*, Vol. 1, No. 3, April, 1979, pp. 3-7.

Gugerty, J., et al. *Tools, Equipment and Machinery Adapted for the Vocational Educator and Employment of the Handicapped*. Project #498749006, Wisconsin Vocational Studies Center, Madison, Wisconsin, January 1981.

Hull, Marc E., Berry, Owen J. and Clark, Donald L., Procedures for Teaching Vocational Concepts to Students with Special Needs. Texas A & M University, Final Report Project 62350274, June 1976.

Vocational Educational Resource Materials, A Bibliography of Materials for Handicapped and Special Education. Third edition, 1978. Wisconsin Vocational Studies Center, University of Wisconsin - Madison.

SECTION IX

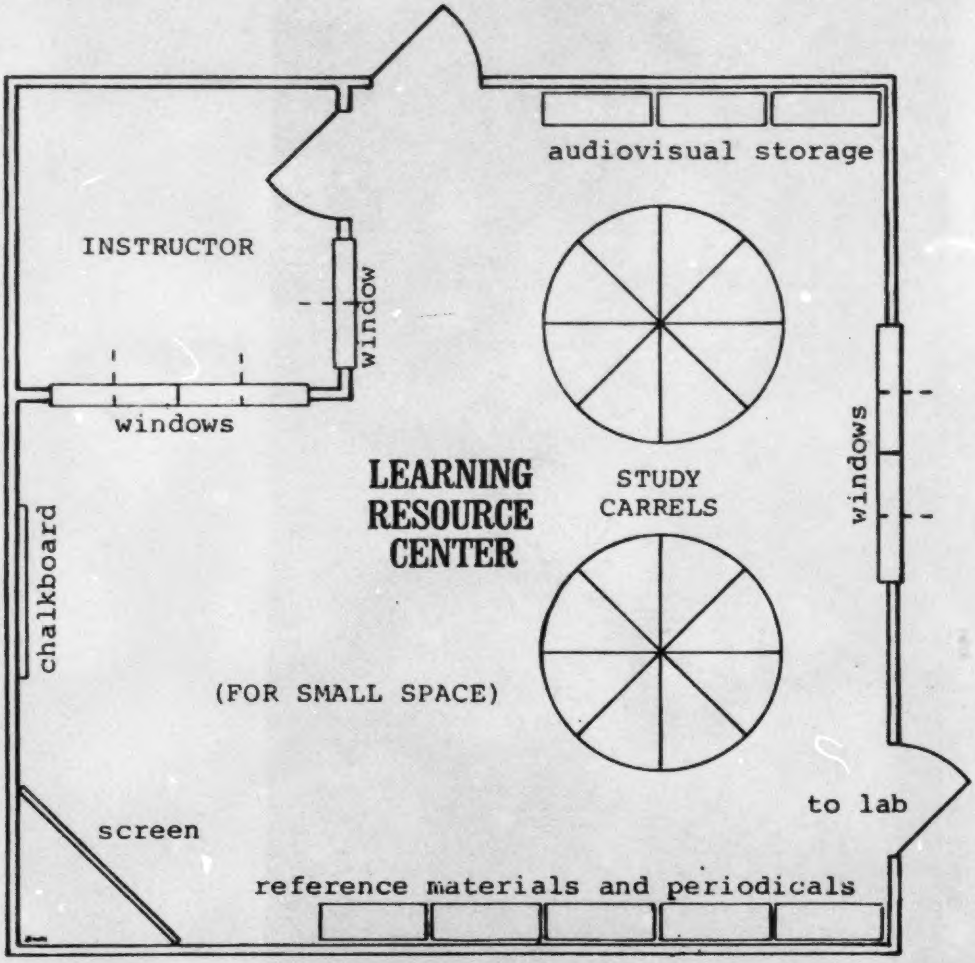
FACILITY LAYOUT

Facility Layout

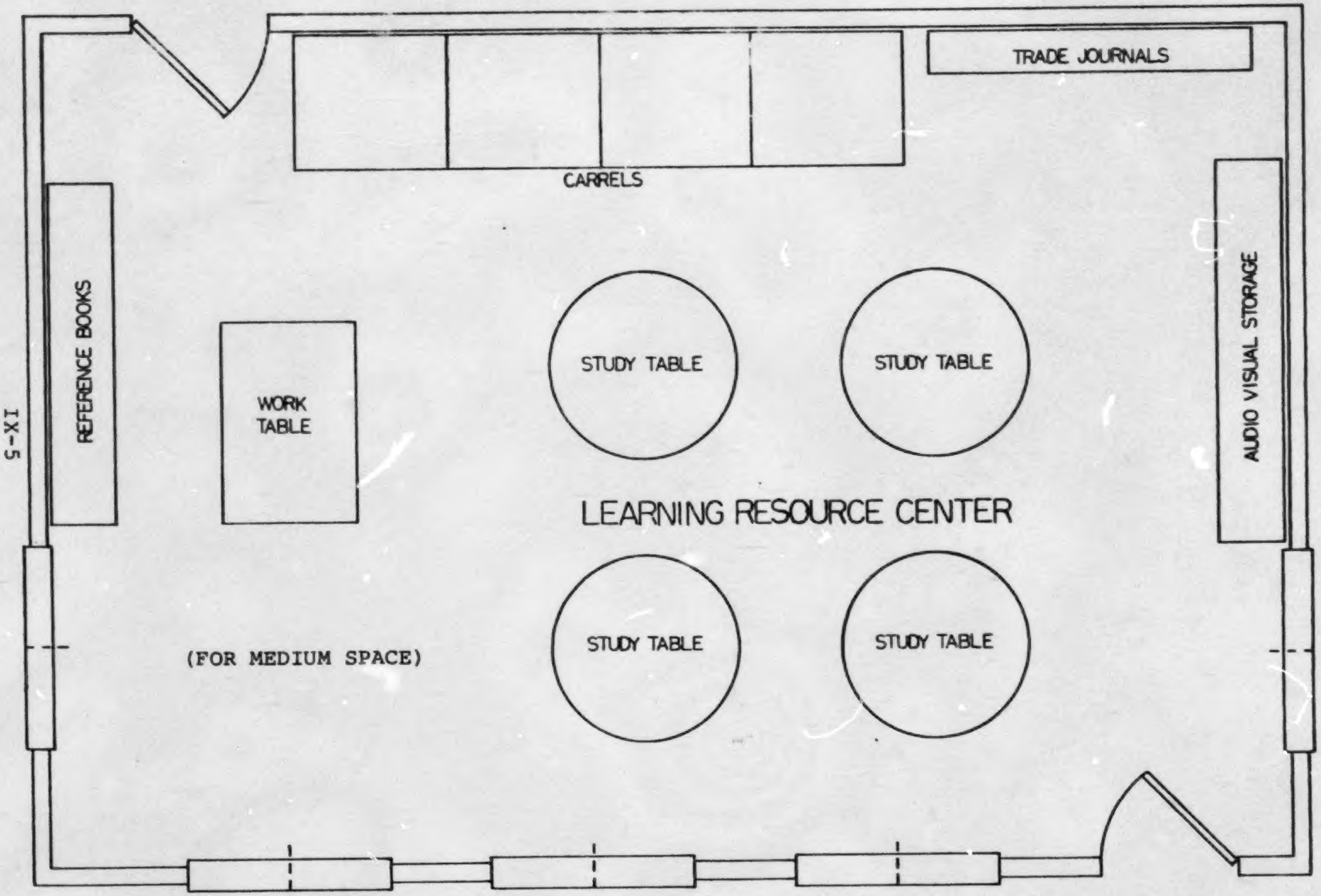
The facility layouts on the following pages are presented to aid in arranging the classroom and laboratory for efficient instruction. The three resource center arrangements represent small, medium and large centers. The instructor must determine an arrangement that best fits the needs of the students and the instructional method being used.

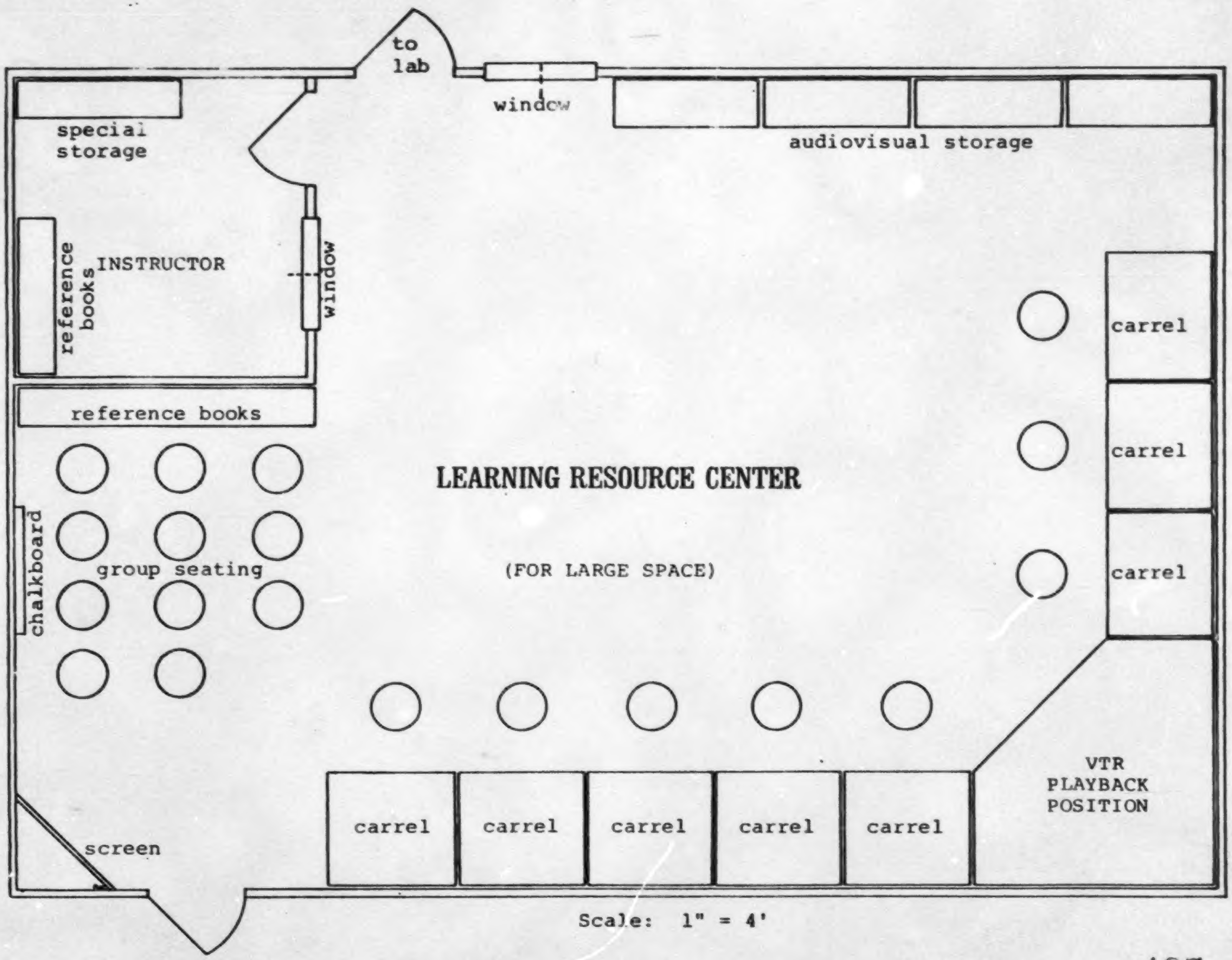
The laboratory facility layouts are recommended by the teachers who helped develop the Refrigeration, Heating and Air Conditioning program materials. This facility is easily adaptable to a variety of arrangements that will best fit local needs.

These layouts may be especially useful in those schools where classroom renovation or construction is being planned.


audiovisual storage
INSTRUCTOR
window
windows
LEARNING RESOURCE CENTER
STUDY CARRELS
windows
chalkboard
(FOR SMALL SPACE)
to lab
screen
reference materials and periodicals

Scale: 1" = 4'

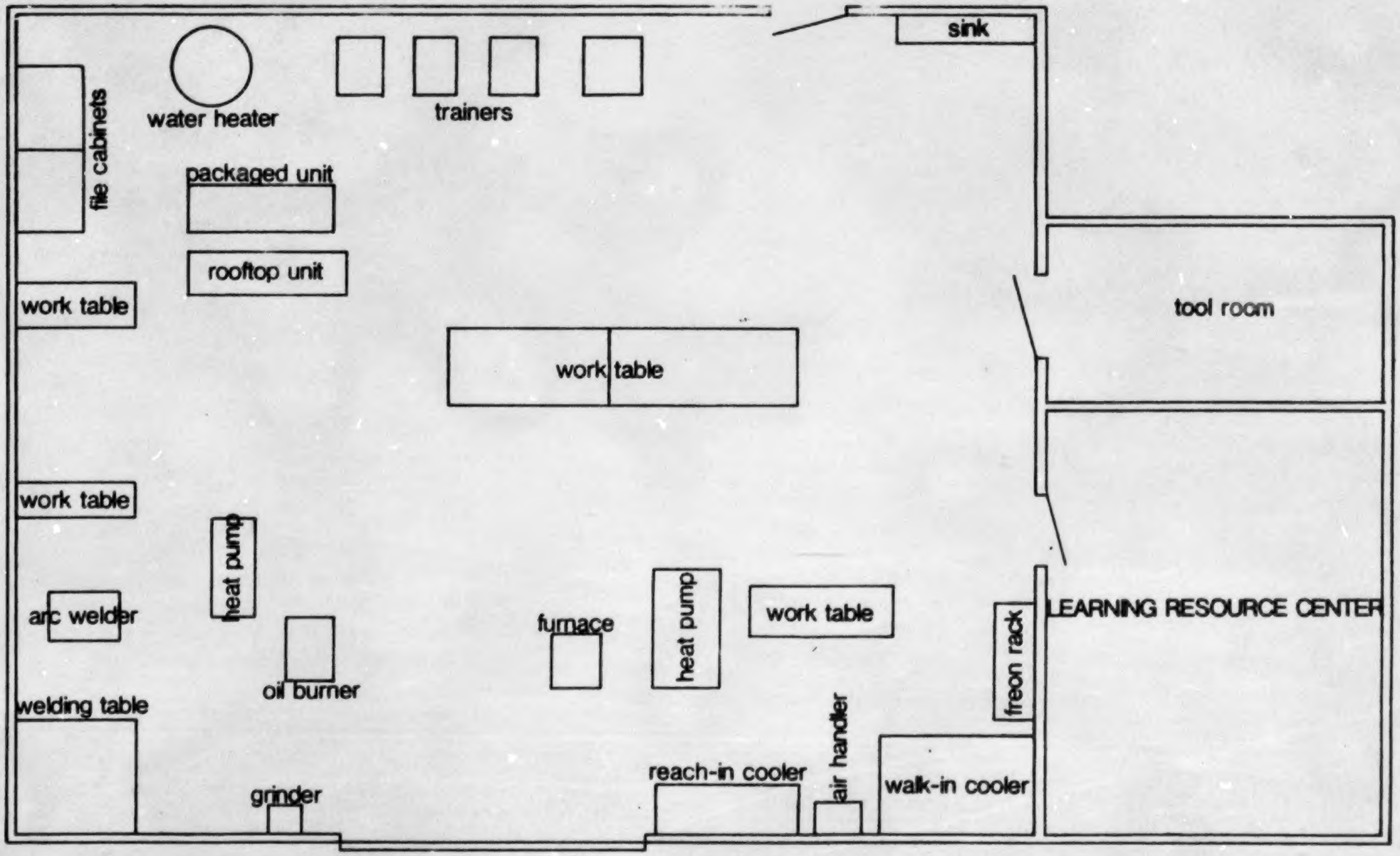

TRADE JOURNALS
CARRELS
REFERENCE BOOKS
WORK TABLE
STUDY TABLE
STUDY TABLE
AUDIO VISUAL STORAGE
LEARNING RESOURCE CENTER
STUDY TABLE
STUDY TABLE
(FOR MEDIUM SPACE)



to lab
window
special storage
audiovisual storage
reference books
INSTRUCTOR
window
reference books
LEARNING RESOURCE CENTER
(FOR LARGE SPACE)
group seating
chalkboard
carrel
carrel
carrel
screen
carrel
carrel
carrel
carrel
carrel
VTR PLAYBACK POSITION

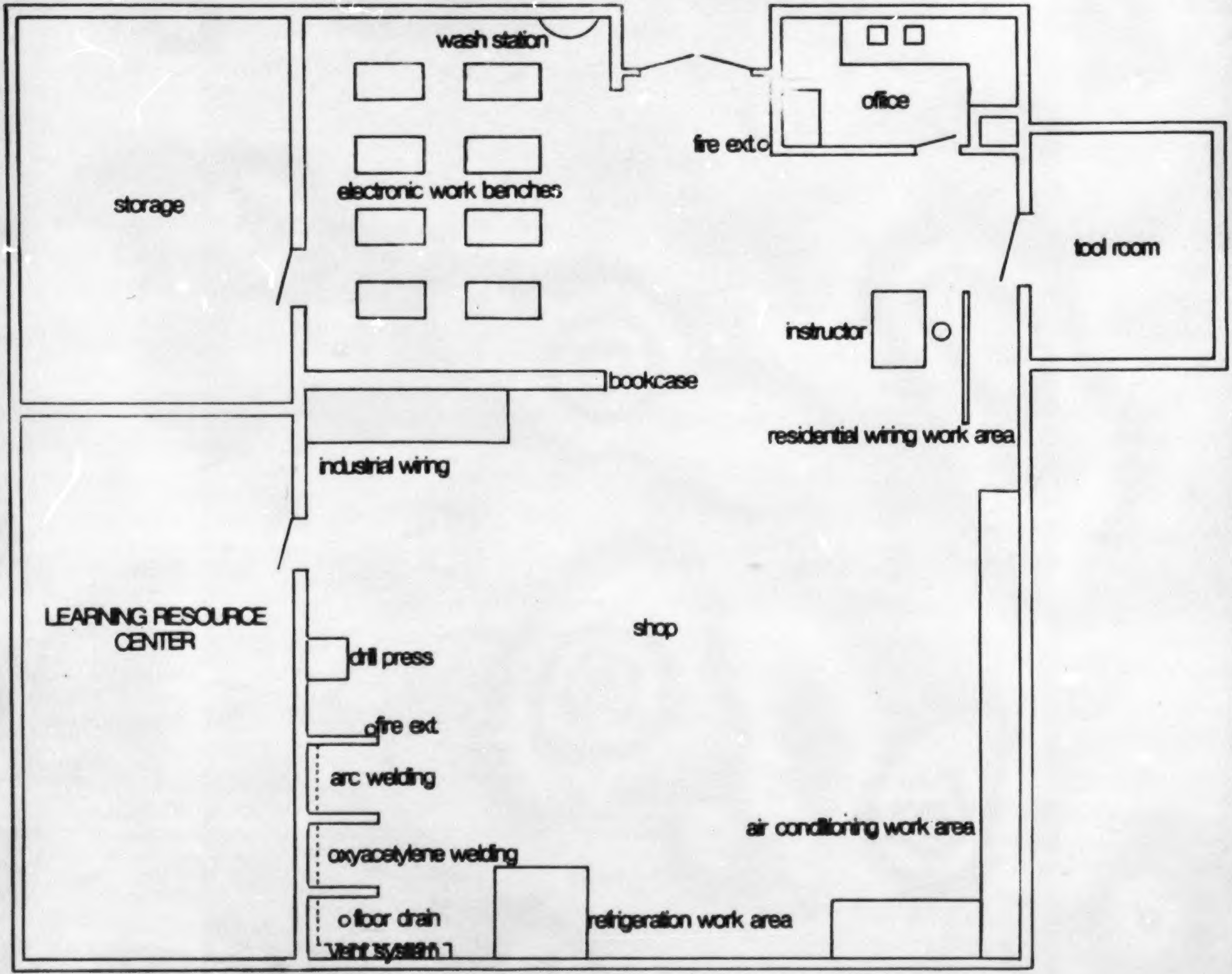
Scale: 1" = 4'

REFRIGERATION, HEATING AND AIR CONDITIONING LABORATORY



sink
water heater
trainers
file cabinets
packaged unit
rooftop unit
work table
tool room
work table
work table
heat pump
arc welder
oil burner
furnace
heat pump
work table
freon rack
LEARNING RESOURCE CENTER
welding table
grinder
reach-in cooler
air handler
walk-in cooler

REFRIGERATION, HEATING AND AIR CONDITIONING LABORATORY


wash station
office
fire ext.
electronic work benches
storage
tool room
instructor
bookcase
residential wiring work area
industrial wiring
LEARNING RESOURCE CENTER
shop
drill press
fire ext.
arc welding
air conditioning work area
oxyacetylene welding
floor drain
refrigeration work area
vent system

SECTION X

DEFINITION OF TERMS

DEFINITION OF TERMS

1. AV's-Audiovisuals - May refer to any picture and/or sound media. (ie. slides, tapes, filmstrips, 16 mm films, etc.)

2. Checkpoint - A student-instructor interface point wherein the instructor may give the student a test, perform a demonstration, or simply provide the student with additional needed information or instructions. Also a checkpoint may be used for motivational purposes.

3. Competency - The ability (knowledge, skills and attitudes) to perform all of a group or cluster of related tasks required to complete a designated activity according to occupational standards. In the educational setting the statement of a competency includes expected student outcomes in terms of knowledge, skills, and attitudes required to complete a designated activity as defined by incumbent workers according to the standards of the work place.

4. Course - A grouping of tasks and competencies which have a common knowledge base or are within a given domain.

5. Criterion-Referenced Measure - An exercise based upon a performance objective, the accomplishment of which measures attainment of that objective.

6. Criterion-Referenced Test - A test designed to measure student competencies based on job or industrial standards.

7. Curriculum Guide - A document containing the objectives, content, organization, and structure of an instructional program. It is designed for use by administrators, instructional supervisors and teachers.

8. D.O.T. - Abbreviation for Dictionary of Occupational Titles. Document provides nine digit codes identifying each occupation.

9. Duty - One of the distinct major activities involved in the work performed, comprising related tasks.

10. Exit Point - A predetermined point within an instructional program in which a student may exit with the essential competencies for a specific job. Usually defined in terms of D.O.T. codes and/or O.E. codes.

11. "Hands-On" - Statement implying the student is physically involved in a learning activity.

12. Individualized Instruction (I.I.) - A system of instruction allowing for a student to progress at their fastest rate.

13. Job - A specific area of specialization within an occupational field consisting of several closely related duties for which a person would expect to receive remuneration. Should be identified by DOT code.

14. Job Sheet - (Or Operations Sheet) - A project of a performance nature. Generally performed by the student in a lab or shop type environment or in a specialized work area.

15. Live Work - Generally refers to items brought into the course area for repair or adjustment. Examples of live work might be automobiles, radios and TV's, air-conditioners, etc. Another form of live work would be patrons visiting the cosmetology department to receive permanents or other services.

16. Master Copies - Original copies of slides, tapes or written materials set aside for the purpose of duplication.

17. Occupational Cluster - A group of occupations sharing a common core of competencies. Georgia's comprehensive high school vocational program is organized around this concept.

18. Occupational Inventory - A listing of tasks to be performed in a particular occupational area, grouped under duty classifications.

19. O.E. - Refers to the U. S. Office of Education. O.E. codes are a classification system (taxonomy) for occupational education programs.

20. Open Entry - Term meaning that a student may enter the program at any time and does not have to wait for quarter or semester breaks.

21. Open Exit - Term meaning that a student may leave a program any time he/she completes their occupational objective.

22. Performance Guide - A series of steps, arranged in a sequence ordinarily followed, which when completed may result in the performance of a task. Also called "teaching steps."

23. Performance Objective - A statement in precise, measurable terms of a particular behavior to be exhibited by a learner under specified conditions. It possesses each of the elements or characteristics specified below:

    a. Condition - The testing situation confronting the learner is clearly specified. This includes equipment provided or withheld, environmental constraints such as temperature, space, etc.

b. Performance - The specific behavior expected of the learner is stated.

c. Standard - The degree of acceptable performance is specified.

24. Performance Test - A test entailing not only the ability to answer questions, but measuring the students' ability to operate, manipulate, or perform a given task as well.

25. Program - An organized sequence of courses leading to an occupational objective. A program may contain one or more student exit points as defined by D.O.T. codes.

26. Program Objective - The outcome of a prescribed program of instruction. Usually expressed in terms of the occupation or job for which training is designed. D.O.T. codes are frequently used to identify program objectives or student exit points.

27. Self-Paced - Refers to a student moving through the prescribed training program at the fastest pace at which the student can meaningfully learn.

28. Sequencing - Putting any set or series of learning activities or tasks into proper order or sequence. Normally arranged from the simple to complex within groupings or blocks.

29. Software - Written or printed materials, slides, filmstrips, tapes, etc.

30. Student Manual - A document designed for use by students in a specific instructional program. It contains unit sheets, references, operational procedures or job sheets, etc.

31. Task - The smallest division of work in which a measurable output occurs. A logical and necessary step in the performance of a duty.

32. Task List - A listing of tasks performed by incumbent workers within a domain of interest. An example is a listing of all tasks performed by an automotive mechanic or by a worker in ornamental horticulture.

33. Unit - One "module" training materials; generally covering one learning task and programmed on one Unit Sheet. May cover more than one lesson.

34. Unit Guide - A curriculum guide sheet that lists a task and objective with the instructional activities, instructional materials, evaluation and approximate time required for a student to successfully complete the task.

35. V-TECS Catalog - A comprehensive collection of performance objectives, performance guides, criterion-referenced measures, and related data, organized by a job structure or career ladder within a domain of interest.

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Title II - Loydia Webber, Vocational Equity Coordinator
Title VI - Peyton Williams Jr., Associate Superintendent of State Schools and Special Services
Title IX - Evelyn Rowe and Myra Tolbert, Coordinators
Section 504 - Jane Lee, Coordinator of Special Education

Inquiries concerning the application of Title II, Title VI, Title IX or Section 504 to the policies and practices of the department may be addressed to the persons listed above at the Georgia Department of Education, State Office Building, Atlanta 30334; to the Regional Office for Civil Rights, Atlanta 30323; or to the Director, Office for Civil Rights, Education Department, Washington, D.C. 20201.